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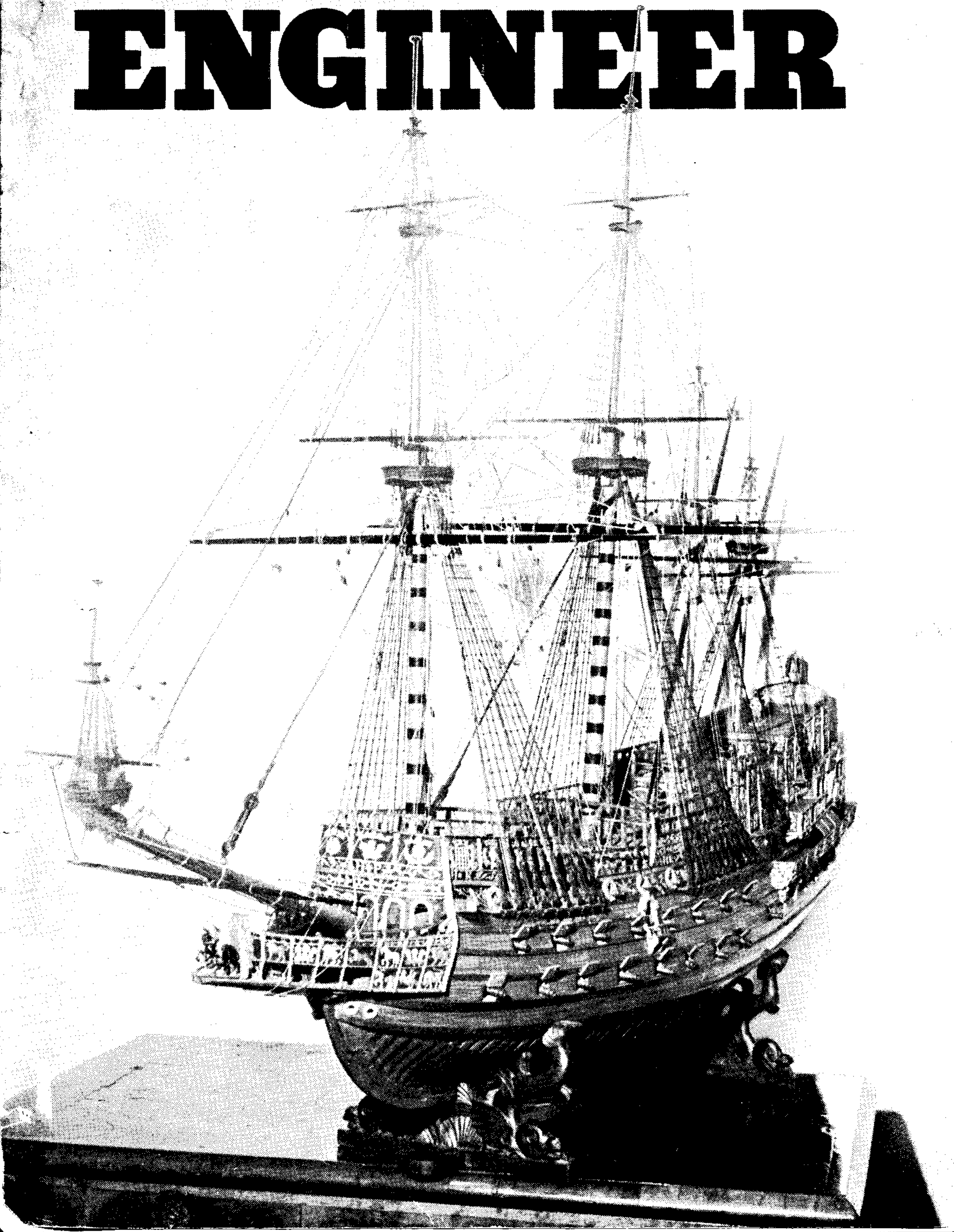
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

27TH DECEMBER 1951 VOL. 105 NO. 2640

SMOKE RINGS

Our Cover Picture

● THIS WEEK'S photograph shows a model of the *Royal Prince* which was built in 1610, during the reign of James I. Although the *Royal Prince* was some 200 tons larger than her immediate predecessors of the late Elizabethan period, she was in many respects very similar to them. She had the same pronounced sheer with a high poop, the same galleon bow with its low beak, the same square tuck and the same general proportions. Many changes were made in the ships which followed her, the most notable being the adoption of three masts instead of four, and the discarding of the low galleon-type bow. The hull and spars of the model in our picture were made by Mr. Robert Spence, of Hampstead, and she was rigged by Mr. A. L. Tucker, of South Norwood. Between them they have produced a magnificent model, which is all the more remarkable as there are no draughts of the original ship in existence, all the information having been obtained from contemporary oil paintings by Vroom and from vague records left of the ships of the period. This is the only model of this ship we have ever seen and, representing as it does a very important step in the transition period between Elizabethan and Stuart ships, would very worthily fill the gap in any of our national collections of ship models.

Greetings

● WITH THIS issue, the last one in Volume 105, we offer to all readers our most cordial good wishes for 1952. The year now closing has been one of the most difficult in the history of our hobby, and there does not seem, at present, to be very much reason to hope that 1952 will see any easing of the difficulties which beset us all.

However, the growth of interest in model engineering, as indicated by the number of new societies which have been formed during the last twelve months, has been well maintained. All over the country, model engineering societies have contributed a by no means insignificant amount of energy and enterprise to the arrangements made for celebrating the Festival of Britain. In this way, our hobby has displayed itself before the general public to a greater extent than ever before and, thereby, can have achieved nothing but good in helping to promote a wider understanding of our activities. So far as can be seen, the indications are set fair for the continued expansion of model engineering; difficulties and restrictions of various kinds may still be there, but the model engineer has always shown himself to be adept in overcoming them, and he will continue to do so.

With this in mind, we look forward with confidence to the coming year.

Model Engineers Can Make It!

● A WARM tribute was paid to the resource, and also the helpful spirit, of amateur model engineers, by the Lord Mayor of Hull, at the opening of the recent exhibition of the Hull S.M.E. He recalled that in the therapeutical department of a hospital with which he had been associated, a new electro-medical apparatus was employed which required a special technique, involving a time cycle of operations. This made it necessary to provide highly skilled and careful attention all the time the machine was in use. It was suggested that the time-cycle might be automatically controlled, but the makers of the apparatus were unable to produce the necessary equipment for this purpose; and enquiries made of a firm manufacturing similar apparatus in the U.S.A. were equally fruitless. The problem was put to members of the Hull S.M.E., who decided that "it could be done"—and within a few months the timing gear was completed and successfully tested. It is now in regular use at the hospital, enabling the apparatus to be more effectively employed and its use to be extended to a greater number of patients than was otherwise possible. Here is another proof that model engineers can tackle real life problems, and employ their talents to the benefit of the community. An illustrated report of the Hull S.M.E. exhibition will be published in an early issue of THE MODEL ENGINEER.

The Fourth Northern Models Exhibition

● THE NORTHERN Association of Model Engineers is now busy organising the fourth Northern Models Exhibition to be held in the Corn Exchange, Hanging Ditch, Manchester, on Friday, Saturday and Sunday, March 21st, 22nd and 23rd next, opening at 11 a.m. each day.

It is hoped that a well-known television personality will perform the opening ceremony on the Friday, while the Rt. Hon. Lord Brabazon of Tara, M.C., will present the awards on the Sunday afternoon.

Entry forms, etc., will be sent to all previous entrants in the near future, but details of how to enter and all other relevant information will be gladly sent to anyone writing to the exhibition secretary, Mr. E. Axon, 5, Winstanley Road, Sale, near Manchester. Entry forms should be completed and returned by January 31st. Models for the loan section will be very acceptable.

A New Locomotive Track Proposed

● AS ANNOUNCED not long ago by Mr. Austen-Walton, the Sussex Miniature Locomotive Society was recently formed. We now learn that plans for a very fine track have been approved and that the Ministry of Housing and Local Government has authorised its construction. Contractors have already received instructions to begin the earthworks; the longitudinal supports and the aluminium-alloy rail have been purchased. A detailed agreement with the local council is expected to be signed very shortly.

We understand that the track will be about 1,200 ft. in circumference, roughly in the shape of the continent of Africa, and half of it will be in a cutting some 6 ft. deep. It encircles lawn tennis courts, bowling greens etc., at Beech Hurst, Haywards Heath, and there is a possibility that, in order to ensure uninterrupted access to these grounds, a short length of tunnel will be built over the track.

Such a track as this, when finished, will be a valuable addition to the attractions of the district, and we are glad to note that the authorities concerned are evidently alive to this fact. We offer our heartiest good wishes for the success of the scheme and we congratulate all concerned upon the energy and enterprise entailed in getting it started.

"Lode Star"

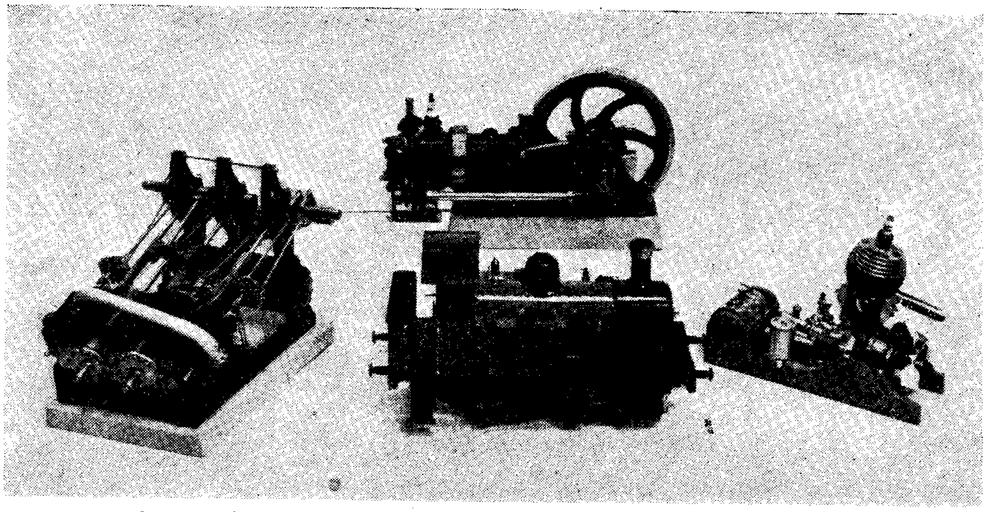
● WE HAVE already announced that the Western Region of British Railways has arranged that engine No. 4003, *Lode Star*, shall be preserved as a memento of the genius of her designer, the late G. J. Churchward. This engine was withdrawn from service in July last, and we understand that during the 44 years 2 months since she first took the road in May, 1907, she has run a total distance of 2,005,858 miles, which is believed to be the largest total mileage yet achieved by a Western Region engine. This may not be a record, but it is a very fine achievement, in view of the fact that very little structural alteration was made to the engine during the time, and also because the engine has been employed on main-line express passenger duties right up to within a few months of her withdrawal.

In this respect, No. 4003 is typical of her class. It is to be doubted whether even Churchward, in 1907, foresaw that his "Star" class was destined to have a profound effect upon locomotive design 25 or 30 years later; yet so it has been. Many of the ideas which Churchward embodied, for the first time, in his "Stars" are now accepted generally as essential for economic performance. Given a good boiler, the proportions of valves and valve-gear, to ensure that the steam should be used in the best possible manner, are now usually worked out in accordance with Churchward's methods. That these ideas were sound is proved by the fact that the "Stars" have been used, when required, on top-link duties long after all comparable engines of their period have gone to the scrap-heap.

At the moment, there are 26 out of the former 73 engines of this celebrated class at work, and any one of them, provided that she is in good condition, can still work a first-class express train to time. No. 4003 was the oldest of them all when she was withdrawn from traffic, and, moreover, was one of the first ten to be built. Therefore, it is fitting that this engine should be selected for preservation; she is to be kept at Swindon until a permanent home can be found for her.

A Change of Secretary

● WE HAVE been advised that Mr. Anthony Murray is now hon. secretary of the Edinburgh and Lothians Miniature Railway Club, in place of Mr. W. Loch Kidston, who has resigned. The address is at the club, Davidsons Mains Station, Edinburgh, 4.



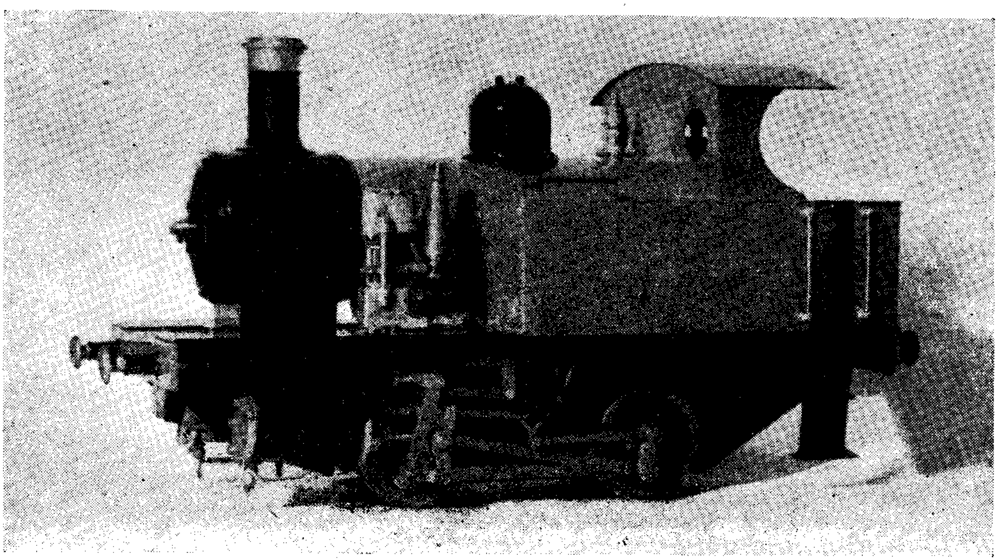
A group of models on show at the Hamilton, New Zealand, model exhibition

The Hamilton, N.Z., Model Exhibition, 1951

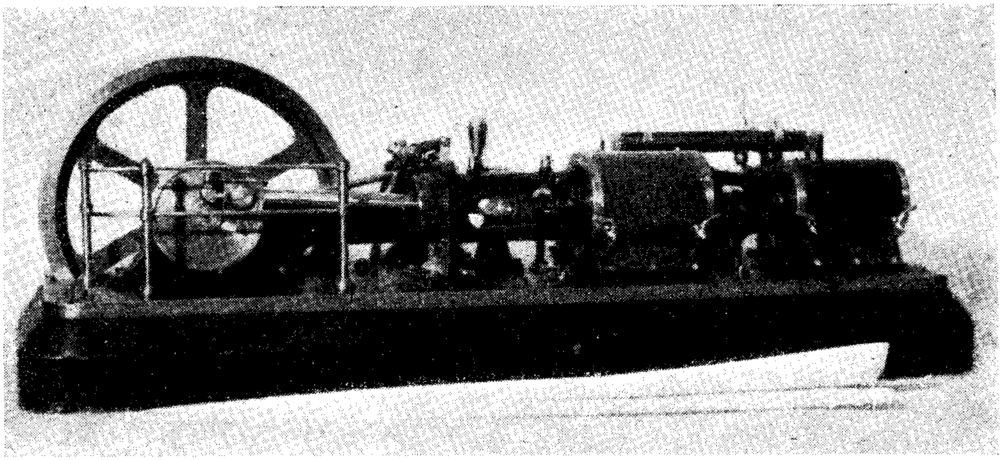
by L. G. Callis

THE annual exhibition of the Waikato Society of Model Engineers and the Hamilton Model Aeroplane Club was successfully staged in the Art Gallery, Hamilton, N.Z. It was opened by the Mayor of Hamilton, Mr. H. D. Caro, who was welcomed by the President of the Waikato Society of Model Engineers, Dr. M. R. Flitchett. Mr. Caro, in congratulating the two societies, expressed his amazement at the high quality and skill in all sections of the exhibition.

One of the most attractive collections of model aircraft, ever seen in Hamilton, was a feature of the exhibition ; it included all types of control line models, and free-flight jobs, powered by rubber, petrol, diesel, glow plug and jet engines. A collection of model planes, from the nearby and



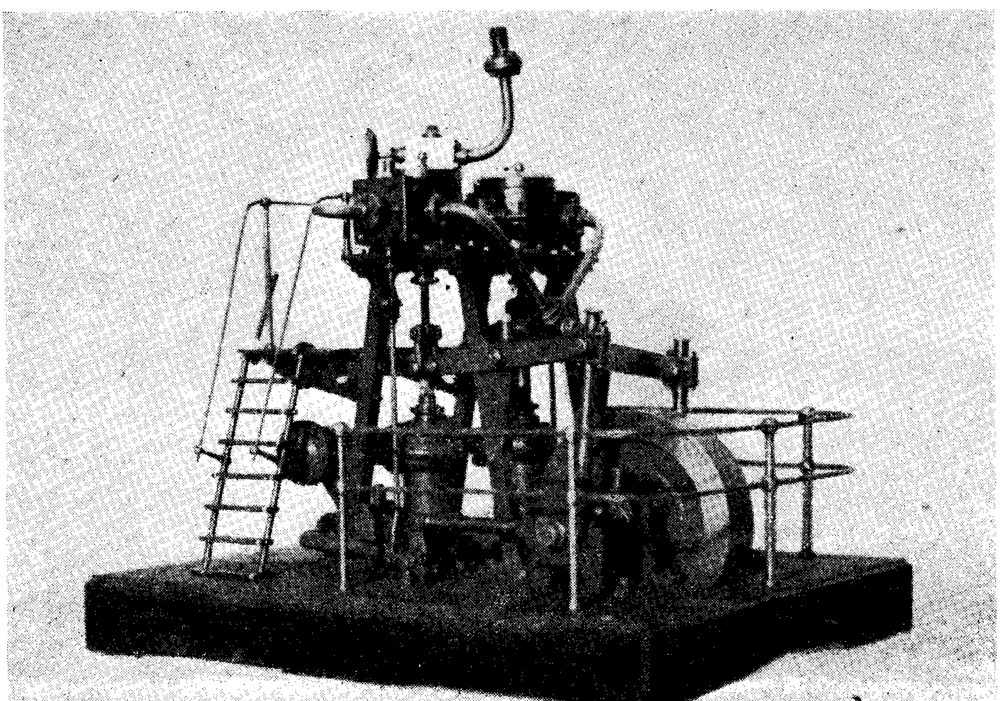
Mr. Gerrard's $2\frac{1}{2}$-in. gauge " Tich "



Mr. Aitken's model tandem compound mill engine

recently formed Cambridge Model Aero Club, was another interesting display, which included scale model "solids" of the planes of World War II days. At one end of the aircraft display, visitors were able to see the wing sections and fuselage of a model aircraft under construction by members of the club.

In the engineering section, most visitors admired the fine Burrell type traction engine, constructed mainly from scrap by Mr. E. D. Morgan; this model, together with a beam engine, and a host of "Stuart" engines, was to be seen running on compressed air. Visitors passing in front of these exhibits were entranced to such a degree that they almost missed the grand display of steam and petrol engine exhibits, that lay a little farther back on the same stand. Also running on the air line, were a part-finished *Juliet*, a tandem compound mill engine, and a twin-cylinder oscillating engine driving a pro-



Mr. Aitken's model vertical pumping engine

peller. At the far end of this display, visitors were able to see two of the very few model hydroplanes in Hamilton.

A few steps from here, and visitors were able to see a typical model engineer's workshop in action; demonstrations in turning, drilling and brazing were given by Mr. G. W. Hope-Johnstone, who during the show was relieved by Mr. L. G. Callis, who in turn demonstrated to visitors the machining of a set of Stuart "10V" engine castings. The centre stand of the exhibition displayed Mr. G. W. Hope-Johnstone's 3½-in. gauge "J" class N.Z.R. locomotive, which is at present undergoing a little "L.B.S.C.-izing," and it is hoped that it will be running at the forthcoming summer show. Also on this stand, visitors could see the club locomotive *Jumbo*, a 7-in. gauge "diesel" locomotive, powered by a 100 c.c. petrol engine; it is to be used for the express purpose of giving rides to the younger generation.

Another grand feature was the display of hand and power tools, made by students of the Hamilton Technical School; among these exhibits were several lathes and a small circular saw, which were made complete, including patterns and castings in the school workshops.

Moving along from here visitors were able to inspect Mr. T. H. Gerrard's fine model *Tich* in 2½-in. gauge, a part-finished *Hielan' Lassie*, a "OO"-gauge railway layout, and a scale model of the Union Steamship Company's *Monowai*. Here, also could be seen a twin-cylinder paddle engine, as well as a "Stuart" gas engine, a first-class job. Other exhibits included an old type gas engine, two model yachts, and a further display of engineers hand tools, made in the home workshop.

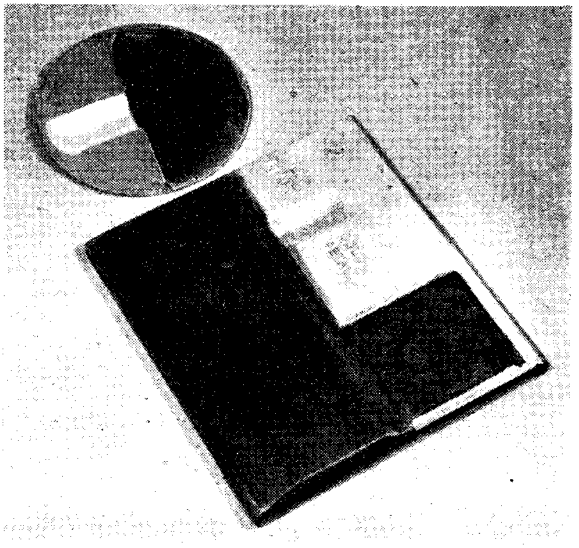
In the general section, Mr. Bryce's prize-winning exhibit was a three-dimensional cross-section model of No. 2 generator at Karapiro power station. Starting at the head gate, the model showed the cutaway penstock tube, followed by a steep descent to the generator, where, after operating the turbine runner, the water is expelled back into the Waikato river.

A NEW COLD PLASTIC METAL

We have recently examined and tested a preparation known as Holt's "Loy" cold plastic metal, which is intended for the repair of holes, dents or blow-holes in castings or other metal parts. It is supplied in tins in the form of a paste, which can be applied by means of an ordinary putty knife. In cases where large areas have to be covered, it is recommended that a foundation should be built up, by means of a special form of fabric sheeting which serves as a bond for the plastic metal, and thereby improves the strength of the repair.

The photograph shows two examples of the application of this material, one being the filling in of a small dent and the other the building up of a large area, using the sheeting material, which is shown projecting on the right of the built-up surface.

"Loy" has many uses in the workshop, garage and home, and it has been successfully used to plug a hole in the upper half of a car engine crank-case, and also to fill up an unwanted opening, measuring ¾ in. × ½ in. in an engine casting. This was filled up with the plastic metal, allowing a slight surplus thickness which was afterwards filed flush and painted. So far, the filling has been entirely successful.



Examples of surfaces and depressions built up by "Loy" cold plastic metal

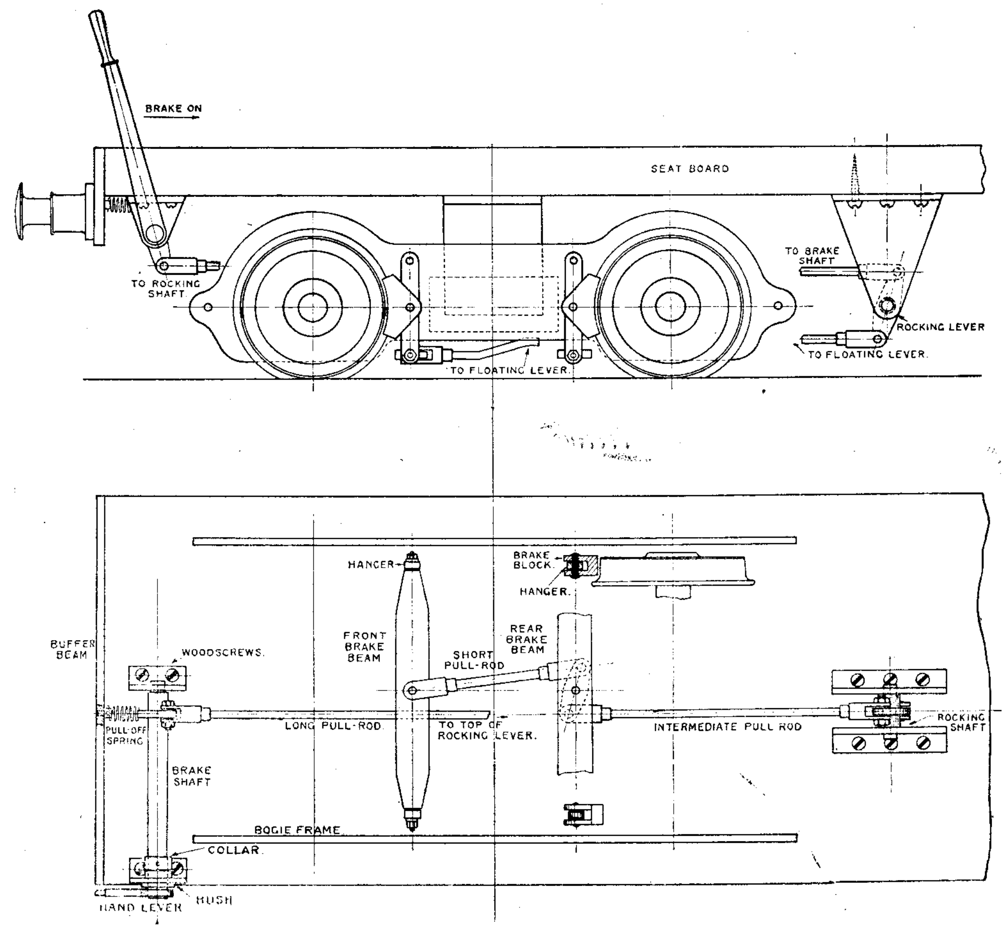
The following claims are made for the product; it is simple to use and can be spread, brushed or sprayed on. An approximate pressure of 65 lb. per sq. in. is normally required for spraying, and for either brushing or spraying, it is thinned out by means of a special solvent. It sets harder than lead, adheres permanently and will not chip, crack, peel or shrink. It can be filed, chiselled, hammered, drilled or tapped, and will take any paint, cellulose, lacquer or synthetic finish in the same way as metal. It is impervious to water, petrol and oils, and will stand pressures up to 150 lb. per sq. in., also temperatures up to 100 deg. C. Its adhesive property enables wood, plastic and canvas surfaces to be treated as successfully as metal. The products that have been described are marketed by Douglas Holt Ltd., Eagle Street, Holborn, W.C.1.

"L.B.S.C.'s" Beginners' Corner

Brake Gear for the Driving Car for "Tich"

IT saves precious time and helps quite a lot, if you know exactly what you are going to do, before you start to do it, especially in the case of inexperienced workers ; a fact that some writers of instructions apparently fail to realise. That is why I always present the complete layout of a boiler, a valve-gear, or other locomotive assembly, before going on to illustrate and describe the various parts that go to make the whole. In my own work, if I didn't "have the job weighed up," in a manner of speaking, I'd never get anything done at all, with the writing, drawing, correspondence and other things to attend to ; time and again I've silently rendered thanks to Nature for the gift of visualising a locomotive so vividly, that I can build it from the mental picture, without any drawings. Bearing the above in mind, here are drawings of the brake assembly for the little driving car, and a few notes on how it operates, which should help our beginner friends, who are building the car, to do the job easily without any trouble.

The brake blocks and hangers are very similar to those on the engine ; but they are inside the frames instead of outside, naturally, and as the blocks have some real hard work to do, they are made from red fibre instead of metal, for two reasons. One is, to save the wheel treads from excessive wear. It is an easy job to remove the



General arrangement and underside view of the brake gear

hangers and fit new brake blocks at long intervals—you'd be surprised how long they last on my own road where there is plenty of traffic—whereas it is harder to remove the wheels and re-turn the treads and flanges ; also they won't stand much of that game before the wheels would need renewal. Secondly, the fibre blocks have much superior gripping power, especially when the wheel treads are oily or greasy. My own locomotives don't smother the rails with oil, but I know plenty that do. It requires very little pressure on the brake lever to make a proper service stop. The brake gear, incidentally, will only be required on one bogie.

How the Gear Operates

Each pair of hangers are connected by a brake beam of the usual pattern, and the leading beam has the usual pull-rod, with central fork or clevis, connected to it ; but unlike the brake on the engine, the back end of the rod isn't connected to the rear beam direct, but to one end of a short double-armed lever which is attached to the middle of the beam in such a way that it pivots or " floats." This is called the floating or compensating lever. From the other end of this lever, another rod goes to the lower end of another double-ended lever, this one being arranged vertically. It is mounted on a short shaft, carried in two V-shaped brackets which are attached to the underside of the seat board. The upper end of this rocking lever is connected by a long rod, to a drop arm mounted on a brake shaft carried in bearings at the front end of the car. This brake shaft is actuated by a hand lever projecting upwards, and mounted on an extension of the brake shaft outside the bearing bracket. The drop arm is extended upwards, and connected to the buffer beam by a fairly stiff tension spring, which normally keeps the brakes in the " off " position.

Application

To apply the brake, the driver pulls back the hand lever, and the drop arm then moves forward, pulling the top end of the vertical rocking lever forward via the long pull-rod. The lower end of the rocking lever then moves backward, pulling the end of the floating lever back via the intermediate pull-rod ; see the underside view of " the whole works." The back beam comes with it, and the rear brake blocks press on their respective wheel treads. When the beam can move back no farther, the floating lever promptly pivots on the rear beam, and the other end of it moves forward, pushing at the front beam via the short pull-rod, and applying the brake blocks to the front wheel treads also. All four brake blocks receive an even pressure, and the car will stop smoothly without sliding or skidding.

Probably some beginners will be inclined to ask why it is necessary to have the intermediate shaft with its long rod connections ; why not dispense with it, and connect the drop arm on the brake shaft, direct to the end of the floating lever. Well, if the car is only intended to run on a straight line, this can actually be done ; but on a curved line, or a continuous track, it wouldn't do, because the direct connection would interfere with the swivelling of the bogie. The lever would move about when the car was running around a curve ; and when the brake was applied, the whole bogie would endeavour to turn, with risk of derailment. Having the extra shaft, which operates the brake gear from the centre of the car body—as in full-size practice—allows the bogie to swivel freely without any interference with the action of the brake mechanism. The above arrangement is the final one which I have installed on my own cars, and it works perfectly, as the few personal friends, who run on my road, can testify. Now to construction.

Hangers, Pins and Brake Blocks

The whole bag of tricks is an exceedingly simple job. The hangers are merely $1\frac{3}{4}$ in. lengths of $\frac{1}{4}$ in. × $\frac{1}{8}$ in. mild-steel ; drill three No. 30 holes in each, and round off the ends as shown. The method of making the fibre brake blocks naturally will differ a little from that employed for metal ones, as obviously you can't solder fibre to a brass plate ; but if each block is cut from a piece of fibre $\frac{5}{16}$ in. thick, and the pinhole drilled in each, they could be screwed to the brass plate, and the curved side formed in exactly the same way as the metal blocks on the engine. However, the easiest way would be to mark the outline of the blocks on the fibre, saw to outline, and finish with a file ; the curved edge can be finished to outline with a coping saw, or even a fretsaw. There is no need to file it ; friction against the wheel tread will soon smooth it off. As a matter of fact, there is no need to file the blocks at all, to a posh finish ; they are out of sight, anyway, and even if they weren't—well, did *you* ever see a full-sized locomotive, or any other piece of rolling-stock, with anything but rough-cast brake blocks ? If you did, you've a darn sight better vision, and powers of observation, than your humble servant could ever claim !

The backs of the blocks can be slotted with a file, or milled, planed, or finished on a shaper, whichever method suits the builder best. Note : the hangers should fit in the slots fairly tightly ; easy enough to allow the blocks to bed themselves correctly to the wheels, when the driver " plonks 'em on," but not slack enough to let them lop over and rub against the wheel treads when the brakes are off. Put the hangers in the slots, and pin them with bits of $\frac{1}{8}$ in. round silver-steel, which should be a tight fit in the holes in the brake blocks, and free in the hangers.

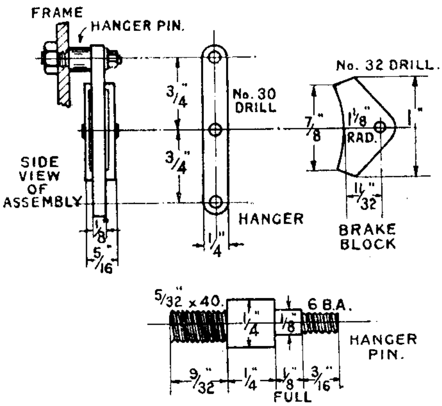
Hanger Pins

The hanger pins are turned from $\frac{1}{4}$-in. round mild-steel. Chuck in three-jaw, face the end, and turn down $\frac{5}{16}$ in. full length to $\frac{1}{8}$ in. diameter. Further reduce $\frac{3}{16}$ in. length to 7/64 in. diameter, and screw 6-B.A. Part off at a bare $\frac{7}{8}$ in. from the end. Reverse in chuck, and turn down 9/32 in. length to 5/32 in. diameter, screwing 5/32 in. × 40. Nuts can be made from $\frac{5}{16}$-in. hexagon rod, either brass or steel, as 40-thread 5/32-in. nuts are not made commercially, and they hold better than the standard 5/32-in. × 32 nuts on a stud threaded to correspond. Poke the plain part of the pins through the top of the

hangers, and secure with commercial washers and 6-B.A. nuts. The hanger should fit nicely on the pin, swinging easily without too much end movement. The 5/32 in. ends of the pins go through the No. 21 holes in the frames, and are nutted outside, as shown in the end view.

Brake Beams and Floating Lever

The brake beams are made in pretty much the same way as those on the engine. Two pieces of $\frac{1}{2}$ in. × $\frac{1}{8}$ in. steel are needed, each barely 4$\frac{3}{8}$ in. long. Chuck truly in four-jaw; face off, and



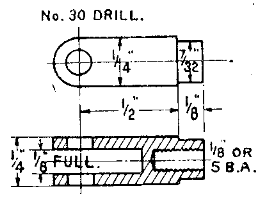
Brake blocks and hangers

turn 9/32 in. length to $\frac{1}{8}$ in. diameter. Further reduce a bare 5/32 in. to 3/32 in. diameter, and screw 3/32 in. or 7-B.A. Reverse in chuck, and ditto repeato operations on the opposite end, leaving 3$\frac{3}{4}$ in. between the shoulders. File to shape shown; or you can make them completely oval, if you fancy, like the floating lever. Some folk object to anything that reminds them of a coffin! Drill a No. 30 hole in the middle.

The floating lever is made from a piece of $\frac{3}{8}$ in. × $\frac{1}{8}$ in. mild-steel a full 1 in. long. Scribe a line down the middle of it, and drill three No. 30 holes on the line, one in the centre, and one at $\frac{3}{8}$ in. from each side. Round off the ends, and file to shape as shown. A special mounting is needed, to fit this to the rear brake beam. Chuck a piece of $\frac{3}{8}$-in. round mild-steel in three-jaw; face the end, and turn down a full $\frac{1}{4}$ in. to $\frac{1}{8}$ in. diameter. Further reduce $\frac{1}{8}$ in. length to 3/32 in. diameter, and part off at $\frac{1}{4}$ in. from the shoulder. Reverse in chuck, and turn down a bare $\frac{3}{16}$ in. to a tight fit in the centre hole in the floating lever. Drive it through, and rivet over the end, as shown. The $\frac{1}{8}$ in. part should be a nice running fit in the centre hole of the rear brake beam. Put it through; put a 3/32-in. steel washer on the 3/32-in. pip at the end, and rivet the pip over on to the washer, so that the beam is held between the washer and the $\frac{3}{8}$ in. part of the pin, but is quite free to swivel on it. An illustration of the assembly will be seen when the erection of the whole issue is described.

Brake-rod Forks

All the brake-rods are $\frac{1}{8}$ in. diameter, and all the forks, or clevises, as they are known over the big pond, are the same size, so you can go right ahead and make the whole six of them, viz. one for the front brake beam, two for the floating lever, two for the rocker lever, and one for the drop arm on the brake shaft. They are made from $\frac{1}{4}$ in. square steel, and beginners can try their hands at a little bit of small-scale mass-production, thus. Cut three bits of $\frac{1}{4}$-in. square steel each about 2 in. long. Mount a $\frac{1}{8}$-in. saw-type slotting cutter on a spindle—this can be home-made, as I have previously described—and put it in the three-jaw. Clamp each bit of steel under the lathe tool holder, run it up to the cutter, and cut a slot in it about $\frac{7}{16}$ in. deep, same as was detailed out for valve gear and other forked ends. Drill all the cross-holes, putting a bit of $\frac{1}{8}$-in. steel between the jaws, to keep the drill from wandering (or you can drill before slotting if you like, as I usually do) then round



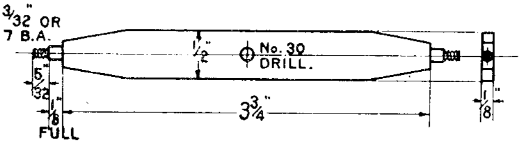
Brake-rod fork

off the ends, and saw off the slotted ends roughly to length, say a little over $\frac{3}{4}$ in. long. Set one up truly in the four-jaw; face the end, centre, drill down a full $\frac{1}{4}$ in. with No. 40 drill, and tap $\frac{1}{8}$ in. or 5 B.A. Turn down $\frac{1}{8}$ in. of the outside to 7/32 in. diameter. Slack jaws 1 and 2, remove finished fork, pop another in, tighten same two jaws, and ditto repeato operations until all six are finished off. Then if you look at the clock, you'll be surprised to find that you have made all six in a little more time than it usually takes to make a single one. Well, that should keep our beginner friends busy until I can make the rest of the drawings.

Life in the Old Gal Yet!

The great-great grand-nanny of all the small passenger-hauling locomotives, old *Ayesha*, who was supposed to fall to pieces in a week, but has now passed her thirtieth birthday, has just emerged unscathed from the worst "pitch-in" yet recorded on my little railway. We don't often have an accident, as my few personal friends behave themselves admirably and observe speed restrictions around the curves, and it is only under exceptional circumstances that strangers "have a go." Yet such is the irony of fate, that an old retired driver, a master of his craft, who never had an accident in all the years he spent on the footplates of full-sized locomotives, came to grief when in charge of a tiny sister! I hadn't seen him for over a year (the few

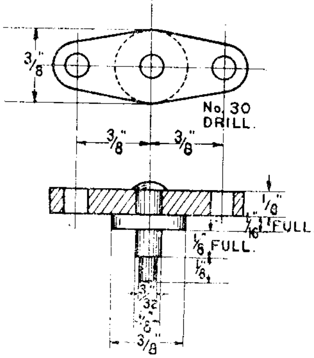
friends I've got, don't worry me much!) and as it was one of the rare fine afternoons when he came over, and I was feeling the need of a breath of fresh air, I suggested taking one of the engines out, and he said he would like to see how the old "Brighton" engine behaved after all her years of hard work. We took her out, got up steam, and I ran her around for a few laps while he admired the operation of the automatic signalling; then I suggested that he had a drive for old times' sake, and got out of the special little short car, with full-length footboards, that I fixed up specially for my few friends. It is easy to ride, as it is too short to tip up, all



Brake beam

eight wheels carry equal load, and the rider is close to the back of the engine, and can reach the handles, also do a bit of firing, without leaning too far forward and "upsetting the apple-cart"!

He started off, and proceeded to do eight or nine laps at a moderate speed; but the fire was low when I handed over, no more had been put on, and the steam began to drop; so he opened the regulator a bit more to maintain speed while he did a bit of stoking. He put on four shovelfulls, and shut the door. Now if there is one thing the old gal knows how to do, better than another, it is to pick up pressure; and by the kindness of another friend, I have a small supply of real good steam coal that lights up quickly and doesn't clinker. The consequence was, that after a couple of dozen puffs going up the bank on the north curve, the steam gauge began to walk up, and the speed rapidly increased going down the west side straight. Before the driver could reach over and shut the regulator a little, she hit the south curve, and then he had all his work cut out to maintain his balance, holding on to the handle at the front of the car. As she left the curve and speeded down the east side straight, she began to blow off, took the bit between her teeth, and just flew—*Queen Mabel* in the tale would have seemed very small potatoes in comparison; the coupling and connecting-rods just faded into a blur, and a cloud of sparks and cinders flew out of the chimney. I saw what was going to happen, and dashed across to catch her, but was just too late! My poor old pal lost his balance and shot clean over the tender, bumping into me and breaking his fall, landing on the tarmac path on his hands and knees; his foot caught the step support of the car, pulling it off the line, and the jerk on the coupling-chain fetched the engine and tender off. I was close to the line as she came over, and she fell between my coat and the longitudinals, checking her fall, then slithered down and finished up on my feet, rolling off on to the tarmac path. I grabbed her and stood her up straight, shutting off steam, and turned to help my friend. He was badly shaken, had grazed his hands rather severely, but otherwise was all right. We lifted the engine on the line again, and I ran her with my own special car until the fire went out. She was undamaged, the only evidence of her adventure being a few scratches on the cylinder



Floating lever

lagging. A wash and some first-aid dressing put my friend to rights, and a cup of the enginemen's best friend put the "all's-well-that-ends-well" to what might have had serious consequences for the old driver; but he has a mighty profound respect for little steam locomotives now!

Jeweller or Engineer?

A. E. Clawson writes:—"Mr. Ackery ('Smoke Rings,' 22-11-51) is as crazy as you or I or the 'cranks at South Bank.' This Yorkshireman who makes push-bikes as big as threepenny bits has a skill and patience that is not ours, but he is more a jeweller than an engineer. The chap who builds boats from match-sticks is equally as clever and as patient in his own way. Every man with a hobby has at some time or other been considered crazy by some person who has not the same interest. A fellow who slaved in his garden all the year round to produce dahlias for a one day show told me that I was mad when I said that I was building a petrol engine without any intention of using it. Which of us is the saner?

"My contention is that any hobby that keeps a man happy and prevents him spending all his time and money on the brewer or the bookie is to be applauded, irrespective of whether it interests us or not."

PETROL ENGINE TOPICS

*"New Engines for Old!"

How an Ancient Gas Engine was Improved, Modernised, and Given a New Lease of Life

by Edgar T. Westbury

THE cylinder of this engine was a single casting, comprising the inner barrel and a cup-shaped jacket, open at the crankshaft end, except for two supporting bars, which were drilled and tapped to take the set-screws holding the cylinder against the vertical face of the body casting. At the head, or "breech" end, as it was usually termed in gas engine practice, a rectangular slot communicating with the actual combustion head in the valve chamber casting.

Open to Criticism

This form of design is open to a good deal of criticism, in respect of both constructional facility and also functional efficiency. In the first place, blind bores are best avoided where possible, as they are always more difficult to machine and finish accurately, and even more so to measure or check up. If there is any merit at all in a blind bored cylinder, it lies in the possibility of avoiding the need for high-pressure gas joints, which does not apply in this case, as the combustion head and valve chamber are still made separately and bolted on. For many years, makers of car and motor-cycle engines preferred to make them all in one piece and avoid the risk of leaky gas joints, but in modern practice, the "detachable head" has proved quite satisfactory, and is now almost universal.

With any form of detachable head, it is very desirable that means should be provided for cooling the head at least as efficiently as the cylinder barrel, to avoid uneven heat distribution which would be liable to cause distortion. No attempt is made to jacket the head in this case, with the result that it gets much hotter than is desirable, and this puts a limit on the engine performance; moreover, the joint between the cylinder and head is liable to become strained by the unequal expansion.

A Near Miss

It will be seen that the two set-screws which secure the valve chamber on this engine are so widely spaced that they are almost in danger of missing the cylinder face altogether! This is another bad feature of design, and quite unnecessary. I would prefer to use a greater number of set screws or studs to secure the head to the cylinder, and possibly to secure the latter to the body as well. However, the drastic alterations needed to put this idea into practice, involving the need for new castings, were not considered justifiable.

The cylinder casting had originally been machined only in the bore, over the spigot at the mouth, and the bolting face at this end; these surfaces having been checked and found reasonably accurate, did not require any further treatment. As the surface at the head-end had only been filed, however (and not very accurately at that!), it was necessary to set the casting up and take a facing cut over it. Owing to the weight and overhang of the casting, and the impracticability of supporting or steadying the outer end, the idea of holding it in the chuck was considered impracticable, and it was therefore mounted by the spigot end in the Keats vee angle plate, as shown in the photograph. A metal plug was made to fit the bore of the cylinder, and inserted therein at the mouth, to take the clamping pressure, and avoid the risk of distorting the bore.

Without Chatter

For the purposes of facing the end of the casting it was not necessary to worry much about concentric truth, but the casting was set to run fairly truly over the outside of the jacket. It may be mentioned that despite the distance of the end face from the mandrel bearings, and the considerable overhung weight, the M.L.7 lathe proved quite adequate to the task, and a fairly heavy cut, necessary to get well under the skin of the casting, was taken without chatter. The tool used was one of the Myford "Quick-set" type, which has a butt-welded high-speed steel tip, and the lathe was run at middle back-gear speed. This was followed by a very light finishing cut at top back-gear speed, which left a smooth and accurate surface to form the bolting face.

Valve Chamber

This also required machining on the bolting face, and also reboring of the valve seatings and guides. When it came to a close examination of the latter, however, serious doubts arose as to whether it would not be better to scrap this component and get a new casting altogether.

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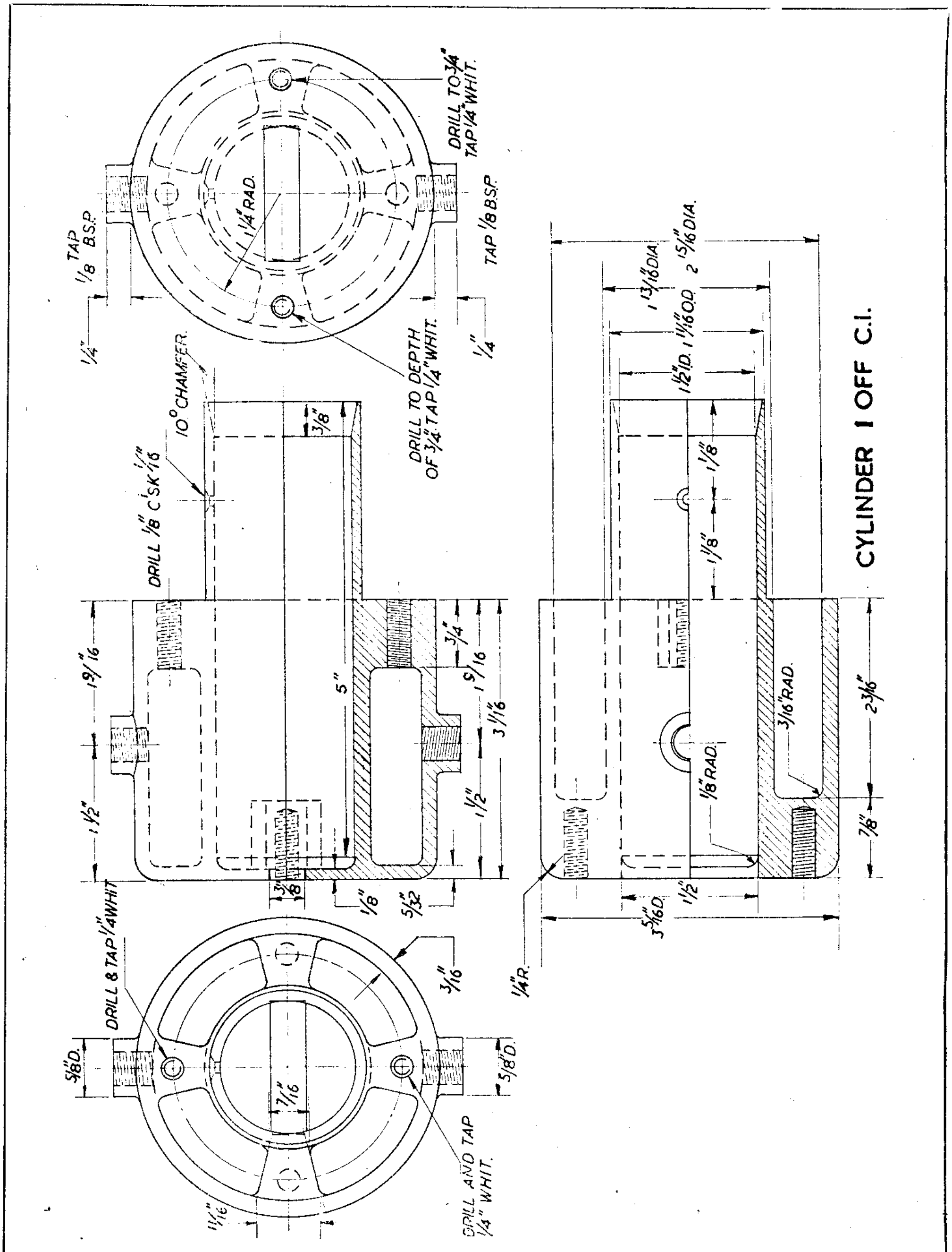
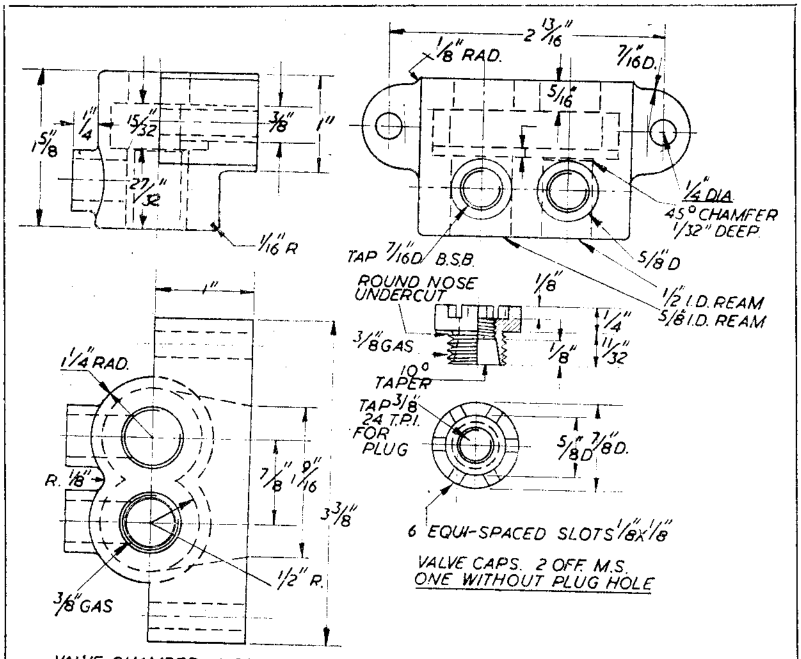
* *Continued from page* 784, "*M.E.*," *December* 13, 1951.



Only the resolution to preserve as much as possible of the identity of the original engine prompted the decision to retain this component, and spend considerable pains in correcting its inaccuracies.

The casting was first set up in the four-jaw chuck and machined on the joint face, again taking the utmost pains to produce a smooth and perfectly flat surface. This was then used as a reference face in subsequent operations, involving the use of an angle-plate, to which the casting was secured by bolts



VALVE CAPS. 2 OFF M.S. ONE WITHOUT PLUG HOLE

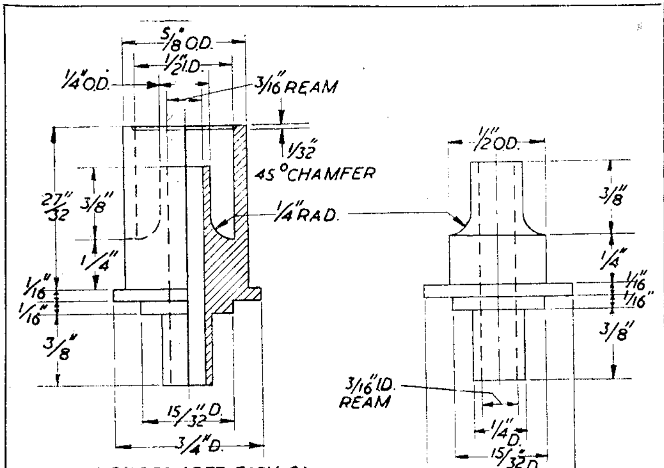
VALVE CHAMBER. 1 OFF C.I.

through its conveniently placed fixing holes.

A cut was first taken over the top face, to produce a true surface, and then, without shifting the work on the angle-plate, the latter was shifted on the faceplate to centre each of the valve ports in turn. Owing to the small distance between the valves, it was impracticable to bore away the existing threads and re-thread the ports to a larger size, therefore it was necessary to set up from these holes—not a very easy operation at any time, and less than ever in this case where, the axial truth of the threads could not be guaranteed.

To facilitate this operation, a screwed plug was made, screwcut 19 t.p.i. to fit the gas thread in the ports, and having a concentric "land" on the outside to enable it to be checked for truth after insertion in the port. The first port to be operated on proved to be fairly true in axial alignment of thread, seating and valve guide. As it was intended to renew the guides in any case, the bore of this one was opened out with a drill and then bored true with a small boring tool; the main port and seating face was also machined, the minimum amount being taken out, as the size of the valve which could be fitted was limited by the core diameter of the thread. Behind the latter, the combustion space was "chambered" out to produce a smooth surface and give maximum clearance around the valve head. Beyond a slight chamfering of the seating, no attempt was made to form the angle at this stage, this operation being carried out later with a piloted cutter used in the hand. The thread was made parallel by the insertion of a plug tap, supported by the back centre to ensure true alignment, before altering the set-up.

When it came to applying the same treatment to the second valve port, however, serious snags were encountered, as the alignment of the bores was about as true as the proverbial dog's hind leg. In the first place, the thread was not in angular alignment with the port, and the latter was out of square with the top face. The only possible way to deal with this error was to bore out the entire guide and seating, so that a new guide and seating could be pressed in from the underside. The use of the plug tap, supported as before from the back centre, enabled the alignment of the thread to be improved, though



VALVE GUIDES. 1 OFF EACH. C.I.

subsequent difficulty in obtaining a tight joint showed that the correction was not as perfect as thought at first.

Careful Fitting Needed

The casting was then reversed on the angle-plate, the machined surface being firmly bedded against the faceplate, and the under surface similarly faced to produce a true seating for the inserts.

In the case of the port first dealt with, a normal form of valve guide, pressed in with about 0.001 in. interference, was used; the second, however, involved making an insert comprising valve seating, port, and guide. As this would be subjected to full cylinder pressure, very careful fitting of this was essential, and it was made to 0.002 in. interference at the top end, but very slightly relieved after the first $\frac{1}{8}$ in., so that the insertion would not require abnormal force, yet ensure that a perfect pressure seal would be obtained where it was really needed.

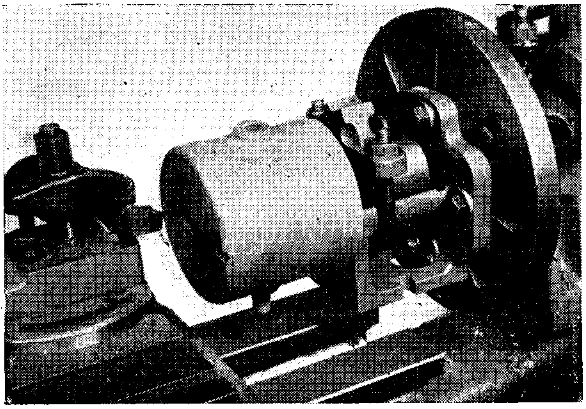
A Special Tool

In order to form the integral valve guide in this insert, a special tool was made, resembling a "hollow mill," to trepan out the annular space between the port and the inner projection of the guide. When the insert was pressed in (using a long bolt and a spigot washer to preserve alignment) a coat of joint varnish was applied to both the mating surfaces; this acted as a lubricant during the operation, and when dry, prevented the possibility of leakage between the surfaces.

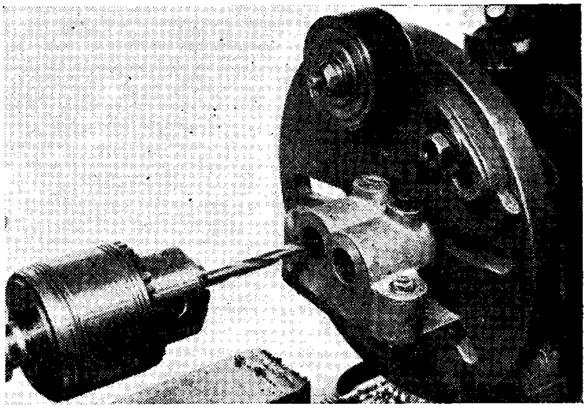
The screwed connections for the inlet and exhaust pipe fittings, which were originally tapped $\frac{1}{8}$ in. gas, were opened out to $\frac{7}{16}$ in. $\times$ 26 t.p.i. to improve gas flow. This involved drilling through the wall of the insert, and it was, therefore, found worth while to set the casting up on the faceplate, to enable the operation to be better controlled than is possible by ordinary drilling methods. The faces of these bosses were also machined to provide true seatings for the fittings.

The valve-seating tool mentioned above was not made specially for this particular job; since I have built quite a few engines in the past, several cutters having an included angle of 90 deg. were available, and it was only necessary to turn a mandrel with a pilot to fit the valve guide bore. A few turns of this with the fingers, applying moderate endwise pressure, sufficed to produce a seating about 1/32 in. wide.

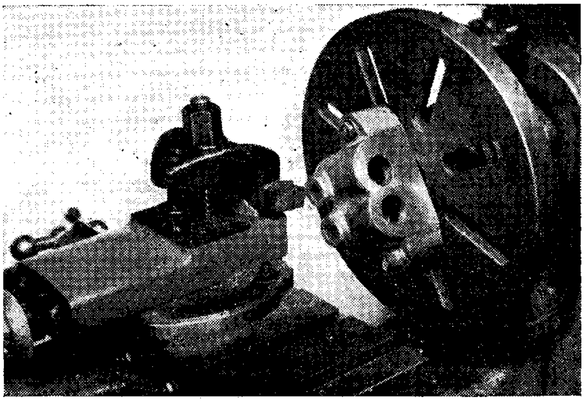
(To be continued)



Machining the back face of the cylinder



Valve chamber set up on faceplate for boring out valve guide and seating



Skimming the joint faces of inlet and exhaust ports

A MODEL ENGINEER'S HORIZONTAL MILLING MACHINE

by J. F. GOWER

I HAVE for a long time felt the necessity for a small horizontal milling machine in my home workshop. A commercial machine, for reasons of cost, was out of the question, so I resolved to construct one with details of my own design. Work was started in January, 1949, and has occupied about two years of spare time. Quite a number of jobs have been carried out on this machine and all have proved very satisfactory as regards speed and accuracy. At the moment, I am limited as regards cutters, but am experimenting with some cut from gauge plate (high carbon steel). Commerical cutters, like so many of our other small tools, fall rather heavily on the small pocket.

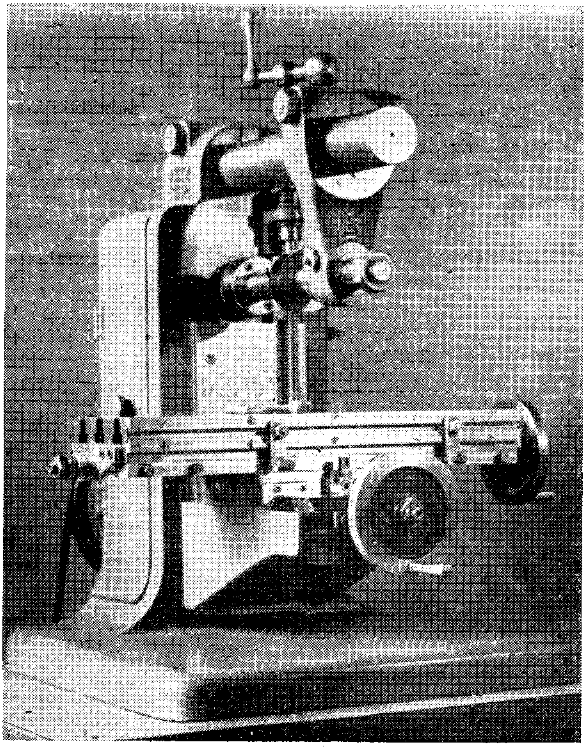


Photo by] [*Norman Verby*

Now for some brief details of the machine itself.

Four essential castings, namely the body, table, knee and arbor support, were obtained through an advertisement in THE MODEL ENGINEER. The "Vee" slides are made of $\frac{5}{8}$ in. × $\frac{3}{8}$ in. B.M.S.B. and secured with $\frac{3}{16}$-in. cheese-head screws. The slide-plates are also made from mild-steel planed and scraped.

The body, which forms the largest single item, presented a problem with regard to boring the main bearings, however, I was fortunate in having the use of a radial drilling machine which I fitted with bar and cutter. The body was clamped down on the vertical-slide facing. Solid gunmetal taper split bearings are fitted, with solid cast-iron bushes for the countershaft, which is housed inside the body.

The spindle is of mild-steel flanged at one end to receive the driving plate which is held with four $\frac{3}{16}$-in. Allen screws. The other end is screwed for two lock-nuts which draw the spindle through the bearing and take up any wear. The arbor is also of mild-steel, and is pulled into the internal taper of the spindle by a $\frac{5}{16}$-in. draw-bolt which passes through the spindle. The driving torque is taken by two keys mating with the driving-plate. The milling cutters are held between distance-pieces clamped by a nut on the arbor. The arbor support is fitted with taper split bearing, similar to the main bearing.

The table has three cored "tee" slots with slides secured with screws as previously mentioned. $\frac{3}{16}$-in. dowel pegs are fitted to all slides to maintain accurate alignment. The cross-traverse slide is fabricated in the same way. The traverse screws are $\frac{3}{8}$ in. × 20 acme, with split gunmetal nuts to take up wear, if necessary.

The knee is actuated by a vertical screw giving 3 in. total movement. The knee can also be locked in any position.

Lubrication has not been neglected. Two grease nipples supply the main bearings *via* unions and pipe; another supplies the arbor bearing and, lastly, one for the slides and nuts. A cover plate is fitted over the cross-traverse screw to exclude swarf and dirt.

The drive is taken from a $\frac{1}{4}$-h.p. motor and countershaft to the machine all by "Vee" belt. A secondary countershaft on the machine transmits the drive to the spindle. Four speeds are obtainable.

The machine was sanded down and a filler applied and then rubbed down to form a smooth surface. The whole was sprayed with matt grey cellulose with white on the interior surfaces. The maker's name plate—GOWER, MANUFACTURER, BEDFORD—was then added to put the finishing touch to a machine which has proved a pleasure to make and a pleasure to use.

My First Attempt

The story of the construction of a $\frac{3}{4}$-in. scale traction engine out of all kinds of odds and ends

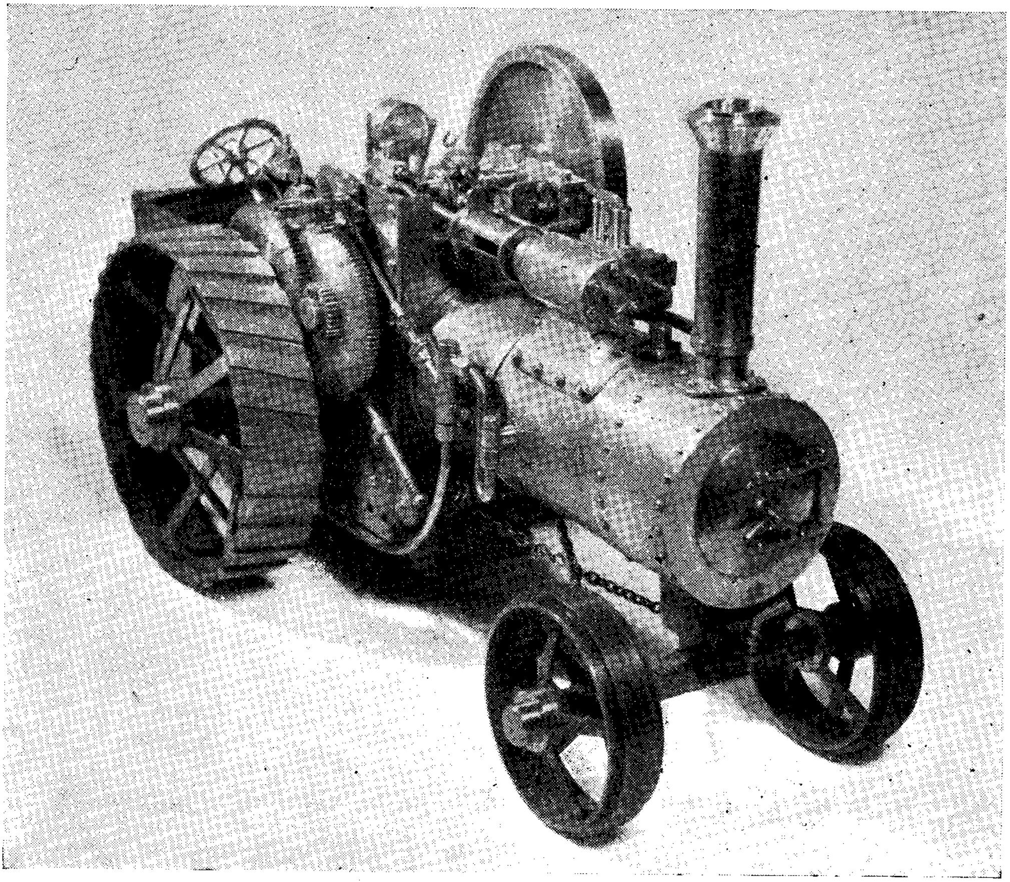
by Thomas Sellars

I AM a native of the Lincolnshire fen country, and in my youth I saw quite a lot of traction engines ploughing the big fields in the fens. Thrashing sets complete with engine, drum, living-van and water-cart, were to be seen almost daily on the roads. Councils, brewers, timber hauliers all used steam—Fodens, Sentinels, etc. It was always my ambition to build a model of one of these engines, and while I was serving in the Forces, I bought a commercial drawing and studied it; during my travels, I collected all sorts of pieces of metal and then, after leaving the Forces and armed only with hand tools and the will to win, I made a start.

The first job was the boiler, which is of Smithies type and made out of a piece of brass tube from a marine engine water system; all joints were silver-soldered and tested to 100 lb. per sq. in. The hornplates were fashioned out of printers' copper plate; the boiler casing was rolled up and soldered and then the lot was assembled.

Now I wanted a lathe; so I bought a cheap $2\frac{1}{2}$-in. one and then started on the smokebox and chimney base. The smokebox door was a commercial casting.

The front axle was built up out of $\frac{5}{16}$-in. square steel; the steering worm and pinion came from a motor-cycle speedometer, and the chain was purchased. Gear studs and rear axle were turned up and fitted to the hornplates.



The wheel rims were rings cut from steel pipe and turned in the lathe, the rear ones only just clearing the lathe bed! Strakes were riveted to the rims of the rear wheels. Spokes were made, "set" in a home-made jig, keyed into the hubs and riveted to the rims. After the chimney had been turned from brass rod, the next job was to tackle the cylinder and motion.

The cylinder was turned out of a bronze steering-pin bush from an old car; the valve-chest made was from brass bar and the valve from a piece of stainless steel. The piston and rod were turned in one piece out of stainless steel, while the front and back cylinder covers, as well as the trunk guide, were turned from brass. The cylinder bore is ½ in. and the piston one ring of graphited yarn.

The valve eccentrics (two) and the eccentric for driving the dummy mechanical lubricator were all turned in one piece (!); they were keyed to the crankshaft after the correct position had been found. Valve-rods and links were made from silver-steel, and the pin-eyes are hardened. The pins, of silver-steel, were hardened and nutted.

Odd scraps of metal were found from which the reversing-rod and lever were made. The flywheel was turned from a stub-end of a line-shaft; it was fitted and keyed to the crankshaft.

And now came a crucial time—the moment for applying the first test. I connected an air line direct to the valve-chest, pumped up the air cylinder to 30 lb. and turned the cock. The engine burst into life and ran smoothly; by regulating the cock, I brought her down to a tick-over and then walked around to examine the motion. All was running quietly.

Gears were now bought and fitted; other details required to finish the job comprised: dummy safety-valves mounted on top of the cylinder, brass bearing lubricators for the main bearings and big-end, throttle-valve, a displacement lubricator made to represent a mechanical one, a four-burner spirit lamp, tanks mounted side by side in the tender to supply spirit and water, and finally, a water feed-pump placed on the offside of the boiler and driven from an eccentric fixed behind the crankshaft sliding gear pinions.

She was now given her first steam trial—stationary. Everything seemed to be all right and to work well; so she was "taken out" and found to run and steer perfectly, forward as well as in reverse. She can be driven at a greater speed than is really becoming for a traction engine!

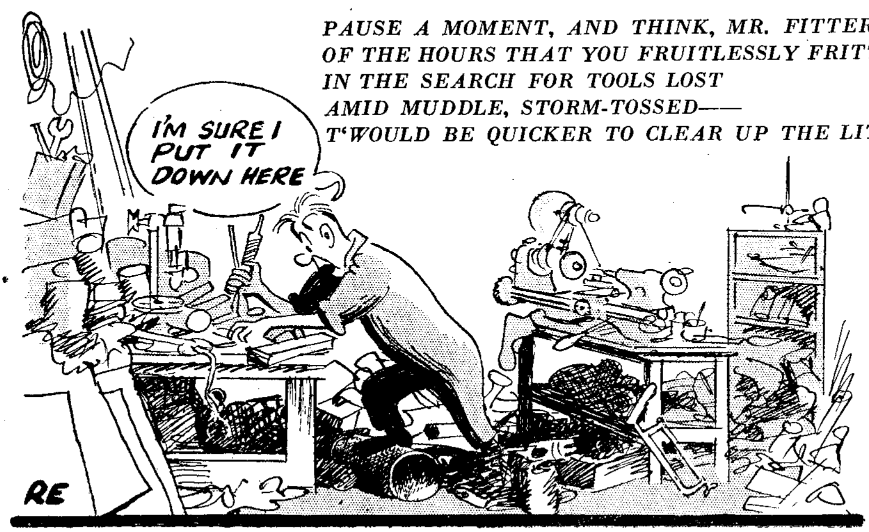
This model has occupied my spare time during five years, and a gearcase has yet to be made; also, she must be painted. All this will be done when time permits. To the expert eye, she may have faults; but we learn by our faults, and I have enjoyed every minute spent on building her.

My friend, Mr. Ron Taylor, was responsible for the excellent photograph.

[We liked this story when we first read it; the plain, straightforward manner in which the tale is told appealed to us. In a covering letter, our contributor states that he has read many of our articles in THE MODEL ENGINEER, but never thought that we should write to him, "a lone hand." His model was in the 1951 "M.E." Exhibition, Class L, No. 8. It did not win an award, but we hope that the publication of the story of its construction will serve as some compensation.—ED., "M.E."]

Whimsical Workshop Warnings

by Rick Elmes



PAUSE A MOMENT, AND THINK, MR. FITTER
OF THE HOURS THAT YOU FRUITLESSLY FRITTER
IN THE SEARCH FOR TOOLS LOST
AMID MUDDLE, STORM-TOSSED——
T'WOULD BE QUICKER TO CLEAR UP THE LITTER!

*A Universal Dividing Head, PLUS

by A. R. Turpin

*Continued from page 821, "M.E.," December 20, 1951.

THE mandrel proper is now mounted on the arbor between centres, turned to size, and the necessary threads screw-cut. This final operation is shown in photo No. 22. The cutting of the keyway will be left until the machine vice has been made. The nut, internally threaded 24 t.p.i., is a straightforward machining job, but do not forget to place a small pad of brass below the end of the Allen set-screw, otherwise the thread on the mandrel will soon be damaged.

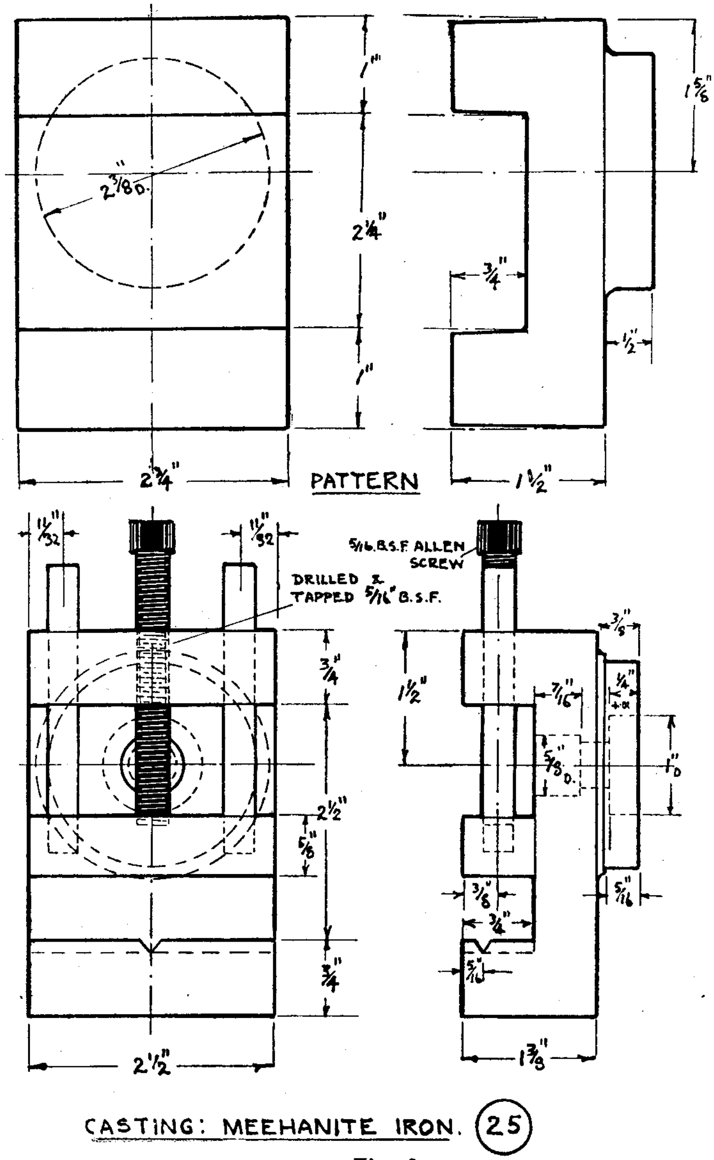


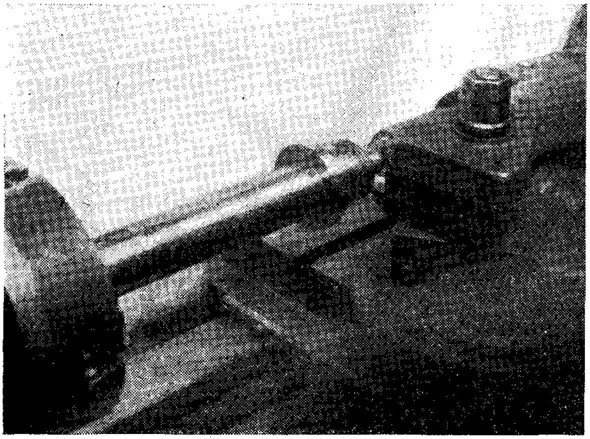
Fig. 18

The Machine Vice (25)

This is shown in Fig. 18. My own vice was fabricated from B.M.S., and was screwed to the carriage by two $\frac{1}{4}$-in. Allen screws, but this had two disadvantages; it was fixed in one position, and that position even at its lowest, was too near centre height to be of great use. I have not constructed the vice shown in the drawing, but as can be seen, it is fixed to the carriage by one Allen screw, and can, therefore, be rotated through 360 deg. and as the fixing screw hole is off centre, a considerably lower feed can be obtained in the vertical position. In order to keep the top surface of the vice level, the back end, when drilled with the three holes, is rather weakened, and it is doubtful if ordinary cast-iron would stand up to the job; a Meehanite casting is recommended.

The pattern is a very simple one to make, and is shown in the same figure.

To machine the vice body, commence by bolting to the faceplate, or gripping in the four-jaw if you have a large enough one; face the circular boss, and then centre drill, and drill right through $\frac{7}{16}$ in. clear, by easy stages. Bore the 1-in. diameter recess to fit the registration boss on the carriage, and then turn down the outside of the boss to $2\frac{1}{8}$in. diameter. Reverse, and counter bore the central hole $\frac{5}{8}$-in. dia-



Photograph No. 22. Cutting the thread on the mandrel nose

meter to take the head of the $\frac{7}{16}$-in. Allen screw, and deep enough to give the head a clearance of $\frac{1}{8}$ in. below the surface. The method of machining the body of the vice will depend on the tools available; in my own case I would bolt it vertically on the pillar, and using the feed on the pillar slide and the cross-slide, machine it all over at one setting with a large end-mill, thus making certain that all the sides are square with each other. I have allowed plenty of metal when dimensioning the pattern, and if you know your foundry you may be able to reduce the machining allowance, and reduce the work involved; this applies to all the patterns, but it is better to have too much than too little allowance.

A $2\frac{1}{2}$ in. length of $\frac{5}{8}$ in. $\times$ $\frac{3}{4}$ in. B.M.S. is now cut, and scraped flat and square. This piece of steel is now placed up against the side of the vice to be drilled, with a piece of wood packing behind it, and then clamped in position with a machine clamp. The vice is now turned to a horizontal position, and the pillar rotated through 90 deg. and the holes for the Allen screw and the round guides drilled. Great care should be taken to ensure that these holes are parallel to each other, and with the base of the vice. The holes for the guide-rods should be reamered with the reamer held in the chuck; the taper end of the reamer will taper the holes in the moving jaw so that the guide-rods can be driven in and will be gripped in them and move with the jaw. The screw hole is then tapped $\frac{5}{16}$-in. B.S.F. for the Allen screw, the tap being held in the drill chuck. The guide-rods are short lenghts of $\frac{5}{16}$-in. diameter silver steel. The final operation is to true up the ends of the moving jaw, which should have been cut a little over size.

A refinement is to mill triangular grooves in the fixed jaw so that round rods can be securely gripped; the longitudinal groove can be cut with a fly cutter, but the other must be cut in the same way as the keyway was cut in the carriage.

The mandrel may now be gripped in this vice, and the keyway cut for the worm wheel, using a Woodruff cutter $\frac{1}{8}$-in.

The Worm and Wheel (13) (11)

To cut the worm, first set the gear chain to cut 6 t.p.i., and then very carefully grind up a tool as shown in Fig. 19. Accuracy is more important than efficiency when cutting the worm and wheel, and so I have kept to round figures to make things easier; but if you use an Acme tool gauge it will be 29 deg. and not 30, as shown in the drawing, but if you haven't a gauge cut one from thin brass, and use the round figure of 30 deg. for simplicity.

Having honed the tool to a fine finish, chuck a short length of $\frac{5}{8}$-in. B.M.S. rod in the four-jaw, and adjust to run dead accurately.

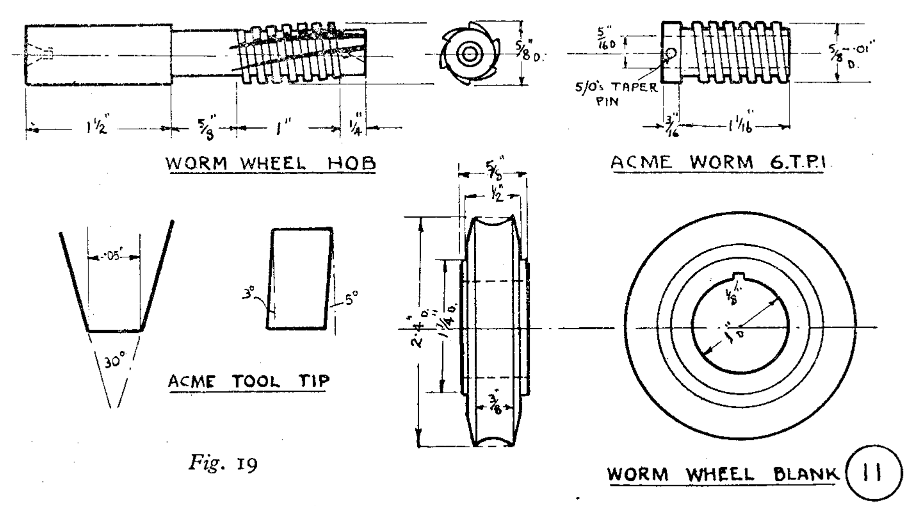


Fig. 19

Face and centre the end and drill right through with a $\frac{1}{4}$-in. drill, and then open out and reamer $\frac{5}{16}$ in., remove from chuck. Mount on a centred arbor a drive fit, and reduce the diameter by 0.01 in. to give a working clearance, the hob being the full $\frac{5}{8}$ in. diameter.

Cut a starting and finishing groove, so that the inside of these edges are 1 in. apart to a depth of 0.07 in., which is the full depth of the thread; the Acme tool being used to do this, and having been set up squarely with the rod. Using feeds of not more than 0.005 in., cut the worm, and when completed to the correct depth, remove mandrel and worm from the lathe, but do not touch or adjust the tool. Now chuck a length of silver-steel rod $\frac{5}{8}$-in. diameter and set to run true with about 2 in. projecting, face and centre, and with the rod left at its full diameter, cut a replica of the worm to depth of 0.07 in. as before. Turn the neck as shown in Fig. 19 and remove from chuck. File, or mill spiral flutes as shown, so that the flutes are deep enough to cut into the core. Accuracy of spacing of these is not important, neither need they be exactly symmetrical.

Remove all burrs with an oilstone slip and then harden and temper to a dark straw. Hone up the front and side faces, and the lands, and the hob is complete.

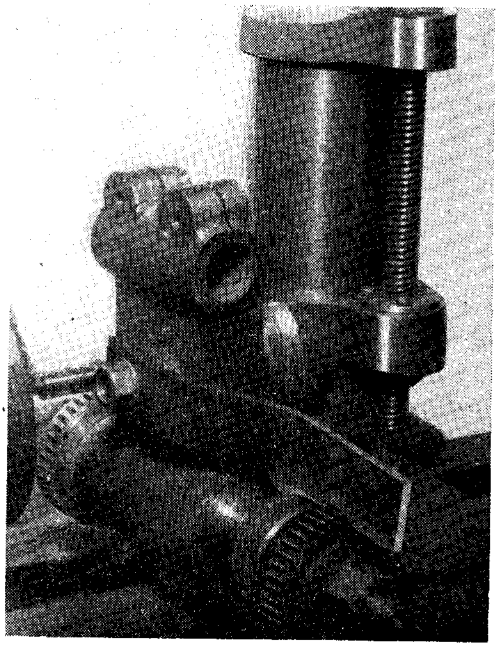
The worm should now be returned to the lathe and parted off to the length shown in the drawing. The drilling of the hole for the taper pin should be left until the spindle has been finished.

As the worm wheel will not be subject to any great stress, the blank may be turned from a piece of brass bar. So chuck a short length with enough protruding for two blanks, face the end and centre drill. Turn the boss; reset, form a groove with a parting tool so that the diameter of the groove is $1\frac{1}{4}$ in., and $\frac{9}{16}$ in. from the end; open this out towards the chuck so that it is $\frac{1}{4}$ in. wide; this will form the second shoulder on the other side of the wheel, see Fig. 19. With a left- and right-hand knife tool, held at an angle in the toolpost, form the chamfers; drill and bore the centre hole $\frac{5}{8}$-in. diameter to a depth of just over $\frac{5}{8}$ in. and part off. This blank is for the worm wheel fitted to the rear of the lathe mandrel if required; no keyway is required, and the radius on the periphery is cut later.

Repeat the procedure, but bore 1 in. diameter, and before parting off cut the keyway to fit $\frac{1}{8}$ in. Woodruff key, this is for the dividing head mandrel.

The next operation is cutting the radius and gashing the worm wheel and to do this, mount the mandrel bearing on the pillar slide, and the mandrel in its bearing, but the reverse way round to that shown in Fig. 1. A key is filed up, and fitted to the mandrel; then the worm blank is mounted on it and the circular nut adjusted so that there is no end play, and yet the mandrel can revolve freely.

A stud replaces the Allen screw securing the mandrel bearing to the carriage, and this stud should be of sufficient length to project $\frac{1}{2}$ in. beyond the nut. A 40-tooth wheel is now mounted on the morse taper arbor previously turned, and this is mounted in the dividing head mandrel, this wheel is used to divide the worm wheel when gashing. A detent is made by cutting a length of 1 in. × $\frac{3}{16}$ in. B.M.S., drilling a $\frac{7}{16}$ in. hole near one end, and threading this over the end of the stud, securing it with a second nut. This strip is now bent so that the further end is centrally over the 40-tooth wheel, and the edge of the strip is filed to fit nicely between the teeth, we then have a rough dividing head. This set-up is shown clearly in photograph No. 23. The dividing head mandrel is now set square and parallel with the lathe bed, a $\frac{1}{2}$ in. diameter fly cutter is mounted centrally over the worm wheel blank, the lathe rotated at top but one speed, and the worm fed into the cutter for a depth of about 10 thous., the gear wheel is now slowly rotated by revolving the worm spindle, and a radius



Photograph No. 23. Set-up for gashing the worm wheel

formed round the periphery of the wheel; continue to feed up the wheel and rotate, until the radius, almost, but not quite, touches the edges. We can now start gashing, and for this we use a circular or fly cutter having an Acme form the same size as the worm.

The dividing head pillar is now rotated so that the mandrel lies at the helix angle of about $4\frac{1}{2}$ deg., the worm wheel end being tilted towards the chuck. Place the temporary detent between the teeth of the 40-tooth wheel, tighten the nut and adjust the cross-slide so that the cutter is centrally over the worm wheel blank, and using the same speed as before, feed the blank up to the cutter; continue to a depth of about 0.06 in., withdraw the cutter, rotate the wheel another tooth, and repeat until you are back where you started.

Remove the flycutter, and replace with the hob, bring back the mandrel so that it is at right-angles to the bed and parallel to it; centre the

wheel under the hob, and with the lathe stationary, raise the wheel until the hob engages with teeth gashed in it ; the detent is, of course, removed so that the wheel can rotate quite freely. Rotate the lathe by hand, and the hob in turn should rotate the wheel ; continue by hand until the wheel has made one complete revolution to see everything is O.K. and if so, engage top back gear speed, and start the lathe. At each revolution of the wheel it should be fed upwards a few thous. until the full depth of tooth is cut ; this will be 7/10 turn of the pillar feed screw ; but as the index has not yet been divided, the handwheel boss can be marked with pencil, which will be accurate enough if a piece of gummed paper the exact circumference of this boss is stepped out to divide it in tenths, and then stuck on the boss. The complete mandrel is now mounted between centres using the same morse taper arbor, and the burrs taken off the worm wheel with an oil-stone slip, and the wheel is completed. The second worm wheel must be left until the dividing head is completed and is then mounted on an arbor instead of the mandrel.

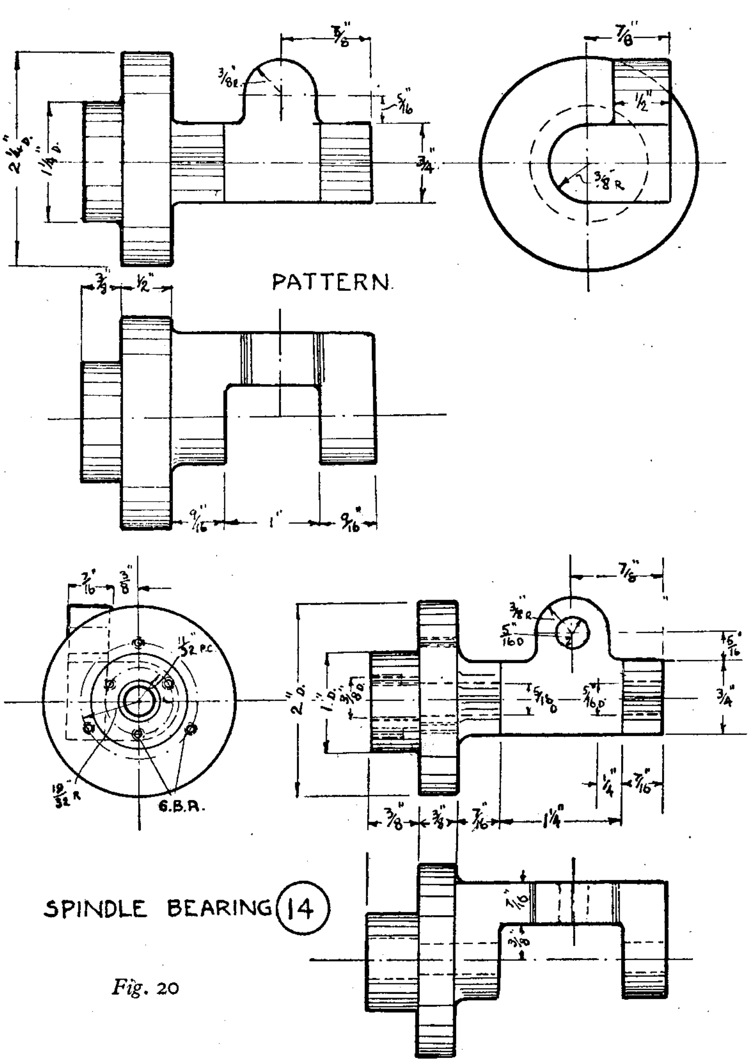


Fig. 20

When cutting the wheel, small irregularities in the gashing will be smoothed out by the hob, but this will only be done if the hob meshes properly with the wheel. The gashes should be deep enough for the threads of the hob to engage at least three teeth, and the flutes of the hob should be spiralled, and narrow enough to ensure that the wheel is never free of the hob. Great care should be taken in the production of the wheel, because it is the most likely point at which inaccuracy of dividing will creep in.

The spindle bearing (14) is shown in Fig. 20 together with the pattern. This may be cast in iron or brass, iron, of course, being the cheaper, and, I think, preferable. The pattern is quite simple and needs no comment except that machine allowance has not been given all round but only on such surfaces that definitely require to be machined to offer a bearing surface ; if it is desired that the other face be machined for appearance sake, then due allowance should be given.

The casting is marked out, and centre punched to show the $\frac{5}{16}$-in. diameter hole in the centre of the circular boss, and also that for the $\frac{5}{16}$-in. fixing-screw. The casting is now gripped in the machine vice mounted on the pillar, and the back machined with an end-mill ; it is then turned so that it lies parallel to the lathe bed, and the hole for the spindle bearing drilled and reamered right through. Start the hole with a B.S.3 centre drill, opening up the hole to the full diameter of the body as previously explained, follow this with a $\frac{1}{4}$-in. drill, and finally an "N" or preferably 7.8 mm. drill and then reamer to $\frac{5}{16}$ in.

(*To be continued*)

*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally but very different internally

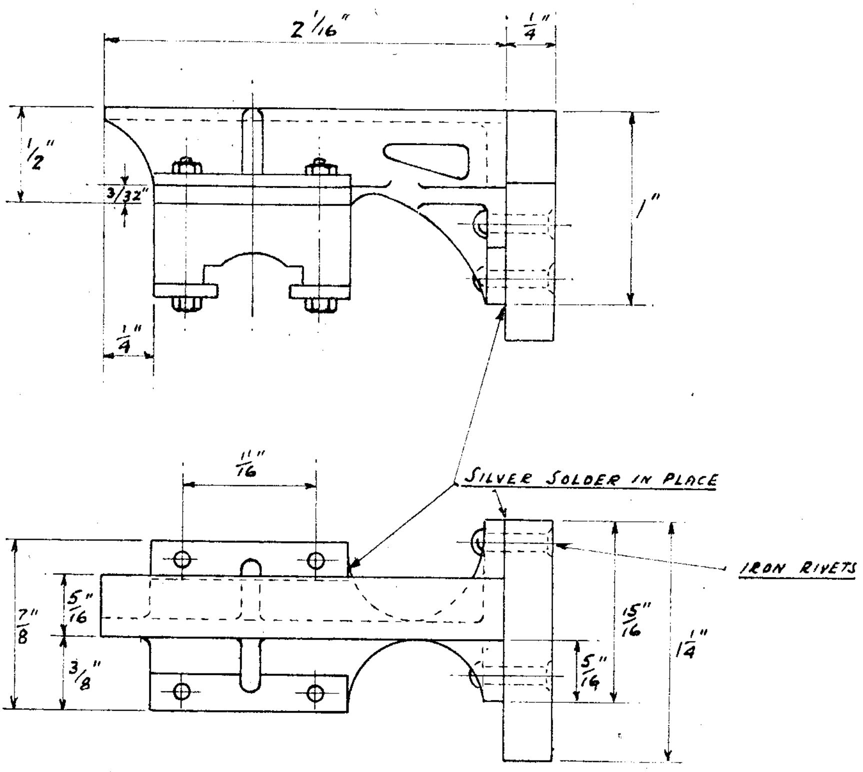
I AM going to start off this week with a number of odd observations ; these cover, in the main part, the subject matter of my always-varied mail.

One of these is in the old familiar request for information that will enable a locomotive builder to paint his engine to a finish that will at least compare with the rest of the workmanship in the job.

By all means let us consider this problem, and at some length—in order to do it justice ; but for the special note of those who have written, let me explain that to deal with the problem *at length, and per person*, by means of separate and individual letters would take up more time than I can really spare at present.

But it shall be done, and soon ; this article and the next is devoted to descriptive matter and drawings, and I do not want to keep builders waiting for longer than is necessary (and there *have* been a few gaps lately).

I happened to mention that some quantity of brass angle would be required for the plate work of the locomotive in the near future, and, as well as advising you to get in stocks for yourselves, ordered some myself. In future, I think, I must qualify such statements when they are made in public, for almost at once a kind friend, who goes up to town quite frequently, came in with a large bundle of angle which he



VALVE GUIDE BRACKET (HANDED. LEFT HAND DRAWN)

1 OFF. EACH. IN GUNMETAL.

Continued from page 628, "*M.E.*," *November* 8, 1951.

presented to me with a gentle curtsey and a broad smile.

By the following post came a bundle of angle as ordered, and a letter from a kind gentleman who offered me some 90 ft. to go on with. Very, very nice indeed, but as I have to pay for the stuff, and feel disinclined to lay out too much money on one particular section for stock purposes, I feel that it puts too many kind people to some trouble on my behalf.

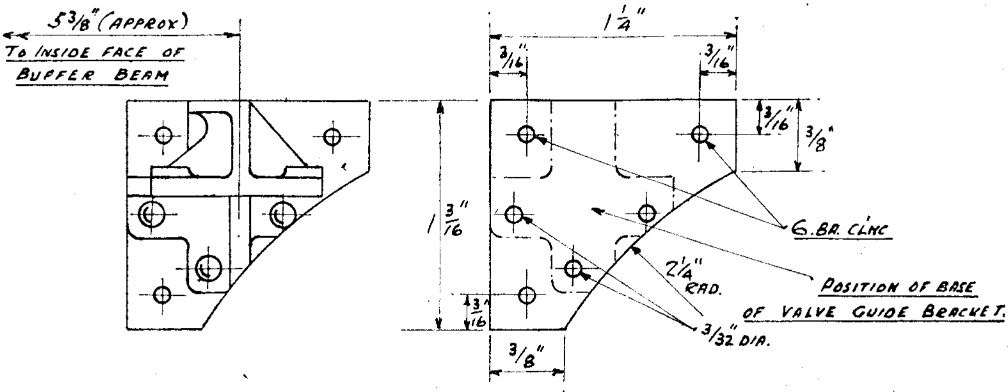
And here is something else that gives me considerable pleasure at times, but also a feeling of embarrassment as well. A short time ago, I promised to let you have a photograph of one of the Manx engines that featured in an escapade of mine. The photograph was dud—from the reproduction point of view, and the whole thing had to be forgotten. Shortly afterwards, a letter arrived containing some excellent shots of engines of the same class; there was no covering letter and I failed to recognise either postmark or writing, and the whole thing had to go without acknowledgment from me. Well, I can at least acknowledge this kind thought here and now, and hope the sender will read this.

Nose, Grindstone, etc.

Now to get down to work. Part of the long-promised drawing this week deals with the valve crosshead guide bracket, and the bits that go with it. Many of you will recognise this as one of the original castings that were (or should have been) issued when the story started. Some of you may have been trying this on the engine and wondering why it was made just a ¼ in. too short, for so it must have appeared. Now is the time to search for them in the scrap-box, and to study them in conjunction with the drawing.

First and foremost, note that these are handed—the handing being most apparent in the way in which the top angle fillet, or platform, turns to right on one, and to left on the other. The edge of this top angle should look forward to the front of the engine if only to keep it in step with the prototype; there are, in fact, other slight differences which you will see by looking at the drawing in plan view, mainly.

Anti-casting merchants might like to fabricate the bracket which, if so treated, would be neat and strong but, whichever method you decide to use, remember that the clearances between the bracket base the wheel rim are none too great, and deserve attention. The whole idea of the false base, which, incidentally, gives the clue to the missing ¼ in., is to provide a greater base area without altering the side-on view of the bracket and its methods of fixing to the frames. It gives also a neat, strong *and* convenient space for fixing bolts for which you will be more than grateful when servicing times come around. To keep up with the general rigidity required, I have specified iron or steel rivets between base and baseplate, and silver-soldering as a further measure of stiffness.



VALVE GUIDE BRACKET BASE

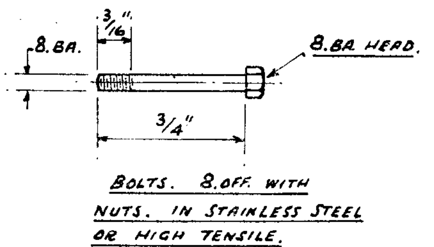
2 OFF – IN BRASS OR STEEL.

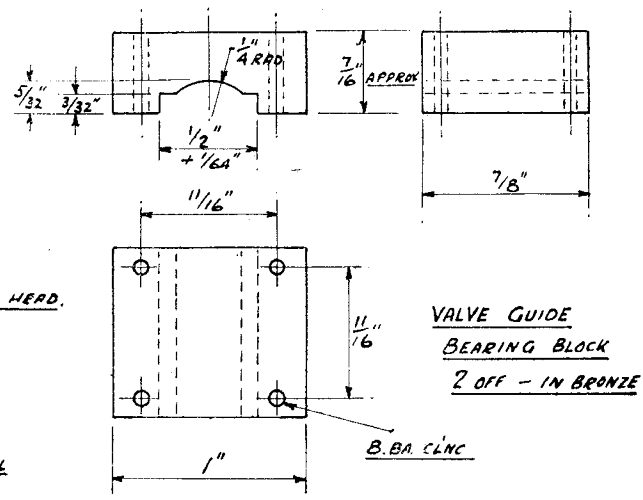
The procedure is therefore as follows:—Clean up the castings by careful filing, in order to remove all pips, sand and flash lines. File or machine the main platform face, remembering that slight remaining pits or cavities will not matter much because this face is not the actual wearing face but only a bearing or seating face—flatness is therefore essential. File the top face of the angle, parallel to the seating platform formed. Hold the casting down on to an angle-plate, set on the faceplate of the lathe and with the platform face in contact, squaring it up to machine the base of the casting. Experts with the file, may prefer to do all these operations with hand tools, especially as the surfaces to be worked on, are so small and so very little metal has to be removed. Now stand the casting on its own base, and square off the sides of the platform first machined, noting the finished dimension given, and continue with filing or machining.

The false base is the next job, and this can be made from either steel or brass, and is so simple in form that nothing is needed from me to describe it. The holes in the casting base can be drilled, and the entire part riveted to the false base, the only care needed here is to see that it is put on fair and square.

Before silver-soldering as suggested, prepare the little false strips that go on the top edges of the platform, so that all the silver-soldering can be carried out at one heat. These strips are not another forgotten item nor a last-minute alteration ; they give the side view of the casting the correct look, being in fact, a faithful representation of the brackets used on the big engine ; but it would not have been possible, without going to a lot of trouble, to cast these in position, as any authority on foundry work will tell you on seeing the part in question.

However, it is very little trouble to add these afterwards, and all " Major " builders should do so, even if we forgive " Minor " men a sly wink. Drill the remaining holes in the brackets,





and generally clean up. The next job is to locate the parts on the engine frames, and drill for same. There is a dimension given for this position, but marked "approximate." The best way of obtaining the exact position can be got when the rest of the valve-gear is assembled and working ; to do this, rotate the wheels, noting the exact travel backwards and forwards of the valve spindle sliding guide member itself. The bracket platform face should come exactly in the middle of this travel—very obviously, and from these observations you should be able to get the right location.

In the other plane, there is little to worry about at this stage ; the top of the angle should come level with the frames at that point, and, if necessary, the actual sliding bearing block should be varied in thickness to suit the case, and the given dimension ignored. There is only one slight snag you may encounter in the process of bolting the base of the bracket to the frames ; the front sand box fixing bolts may have projecting heads to interfere with this. Should this be the case, measure these off for position, and by means of, say, a $\frac{1}{4}$-in. drill, make pockets in the back of the baseplate to clear the heads. The drilling of the locomotive frames themselves need not entail any major dismantling ; I drilled mine with the engine on its side, and under the ordinary drill press, but a small hand electric drill would do the job in fine style.

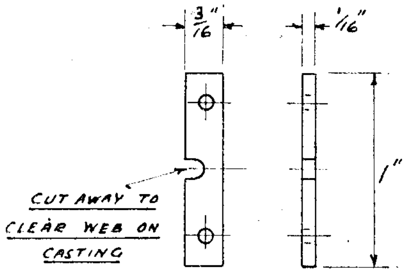
Once the bracket is fitted and bolted up, set a small pair of internal calipers to the space between bracket platform and the sliding member, *and do this on both sides, in case of slight differences* ; the dimensions gained will supersede those given on the drawing, and will have to be worked to instead.

The valve guide bearing blocks are, as the name implies, little more than plain blocks of metal. There is a channel cut right through to provide for the sliding member to work in ; and in addition to this main channel, the " roof " is arched away to give clearance for parts of the adjusting nuts, one on each side of the sliding member to pass. In some positions, just the corners of the nuts may stick up above the sliding face ; the arch cut-away need not be higher or wider than this interference, so either an inverted " V " groove or just a narrow square groove, cut to give the required clearance, would fill the bill. I chose the arch as drawn, mainly for neat and clean appearance.

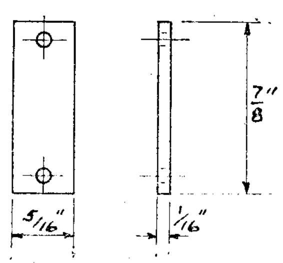
Nothing could be simpler than the two under closing strips, but these should be carefully fitted. When bolted up tight, the sliding member should be free from any up or down movement, but not tight. A small amount of side play is not detrimental but may, in fact, be an advantage. The locomotive frames, however stiffly braced and quite regardless of the *type* of brace, will flex to some extent when the engine is working hard or running on a rough road.

By way of an extra refinement, but not shown on the drawing, a small hole might be drilled down from the top of the actual bracket, through the bearing block to feed oil to the sliding member. This should be about 3/32 in. dia. or a little under, and capable of admitting a small pipe feed from somewhere on the main frames where it would terminate in a tiny oil box. Try to get this hole somewhere in the middle of the bracket—say, close to the plain side of the top angle. The oil pipe would just push into the hole drilled, and would present no difficulties later on when planning the layout of the various oil boxes.

There remain four extra-long bolts and nuts to make, to complete the set, and this is how I do it. I take a piece of round rod, a fair bit



TOP CAPPING.
4 OFF. IN BRASS OR STEEL.
(SILVER SOLDER TO CASTINGS).



VALVE GUIDE BEARING
BLOCK STRIPS.
4 OFF – IN GUNMETAL OR BRONZE.

larger than the finished head size required (where I am going to cut my own hexagon later), and let it project for the whole turned length required, from the chuck jaws. Taking a keen, rather pointed tool, and ground with just a little "toe-in" to prevent away thrust from the tool, I turn down about $\frac{1}{4}$ in. to the diameter of the finished bolt. Noting the number on the cross-slide, I continue to finish a further $\frac{1}{4}$ in. When approaching the chuck jaws, and most of the bolt is finished turned, longer steps may be taken with safety, because there is less overhang or whip from the slender parts hanging in the wind. Some people who have tried this method, have complained of a series of slight ridges where the cuts join up, whilst others say that some materials, that have a lot of stresses tied up in them, tend to distort as the job goes on, leaving a finished bolt that is true to size but sadly out of straight. This is a common fault with most bright rolled steels, due to their final cold working which puts the unwanted stresses in; brass seldom has this fault. The best way of finding out whether the system suits you and your lathe, is to try it out; the whole test should not take more than a few minutes at the most.

An Unfortunate Setback

Quite recently I told you that friend Kennion had secured a supply of near-rustless iron cylinder castings. A small quantity were delivered, and Mr. Kennion, who is always anxious to prove the quality of the goods he sends out, made some exacting tests. These tests showed that the original samples had qualities that were not present in the bulk supplies. However, due to careful management, Mr. Kennion tells me that he has high hopes of getting the *real* article in about three weeks, so we can cheer up again.

To readers who are purchasing the drawings of "Twin Sisters," as they become available. Sheet 17 is now ready and shows details of valve spindle guide bracket, weigh-shaft and linkage.

(To be continued)

TRACTION ENGINE NEWS

S. Morgan writes :—"With regard to enquiries in THE MODEL ENGINEER, as to the whereabouts of some of the once familiar showman's traction engines, one of these appeared with full steam up at the annual carnival held in Yeovil on November 23rd. This engine is a Fowler, named *Excelsior*, road registration numbers O.W. 2253, now owned by Mr. L. J. Casely of Sherbourne, Dorset. Its condition appears to be excellent, as it still retains most of its showland fittings. The name of the owners, usually found on the side of the canopy roof, had been removed, and in their place there appeared just two words—STEAM SUPREME. Is Mr. Casely a champion of steam, one wonders?

Whereabouts of other showman engines, familiar many years ago in south-west England, belonging to Anderton and Rowlands, are as follows, according to "The World's Fair" of November 17th, 1951 :—

Burrell No. 3896, *Earl Beatty* was new in 1921 and is now at Cinderford, Glos, owned by Mr. J. Weaver.

Burrell No. 3833, *Queen Mary* is now owned by Mr. V. Kirk of Oxford.

Burrell No. 3912, *The Dragon*, new in 1922 is now owned by Mr. Vines of Hardwicke, Glos.

Burrell No. 3443, *Lord Nelson*, this engine is apparently also owned by the same Mr. Vines.

Fowler No. 19762, *The Lion*, as already reported, owned by Mr. E. A. Lucas of Salisbury.

I trust the above information may be of interest to other traction engine enthusiasts."

IN THE WORKSHOP

by "Duplex"

No. 105.—*Making a Twist Drill Grinding Jig

THE purpose of the stop-arm and stop-plate (*M* and *N*) is to limit the forward travel of the drill slide so that it is always kept clear of the grinding wheel; in addition, this stop mechanism ensures that the projection of the drill beyond the lip gauge remains constant. As will be seen in the illustrations, the stop-arm is attached to the side of the drill rest by means of two 6-B.A. cheese-headed screws, and the adjustable stop-plate is secured to the baseplate. When, therefore, the jig is rotated on its pivot until checked by the pivot stop (*K*), the stop mechanism will check the forward travel of the drill slide and will thus set the clearance between the lip gauge and the face of the grinding wheel. It should be noted that, as the drill slide moves forward at an angle of 10 deg., the width of the slot filed in the table for the leg of the stop-arm must be increased accordingly, as can be clearly seen in Fig. 33. The stop-plate is slotted to provide a means of adjustment, and its long securing-screw serves also to attach the base bracket to the baseplate.

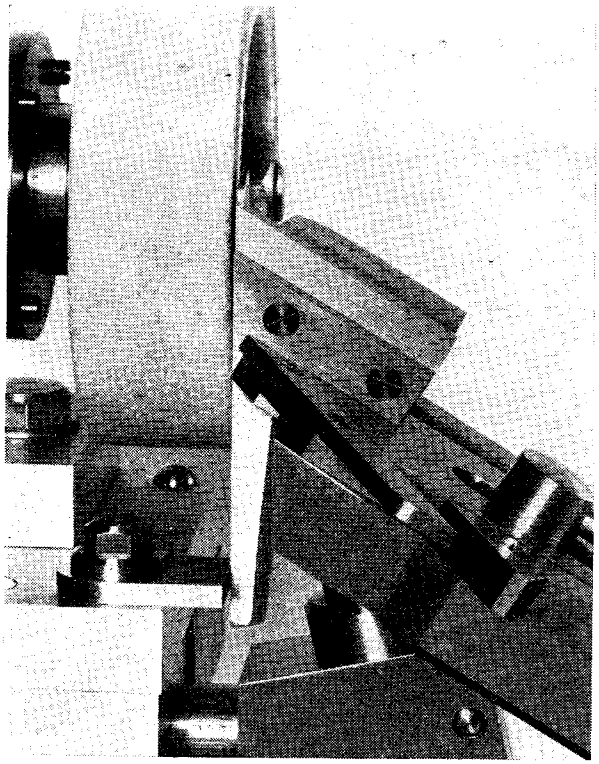


Fig. 37. Showing the position of the stop-arm and stop-plate

The Caliper Jaws (S and T)

As previously explained, the drill when being ground is set forward of the main pivot axis for a distance equal to 1.4 times the drill's diameter, and it is this that largely determines the amount of back-off obtained. The contact faces of the calipers are, therefore, set at an angle of 48 deg. to the datum face on the right-hand edge of the drill slide, bearing in mind that the drill slide moves at an angle of 10 deg. to the drill axis. By this means, closing the calipers on the shank of a $\frac{1}{2}$ in. dia. drill, for example, will advance the drill slide for 0.7 in. beyond the zero position.

After the forward caliper jaw has been attached to the drill slide with two 6-B.A. cheese-headed screws, the drill slide is set in the zero position and the clamp-bolt is securely tightened. The lower jaw is then placed in position on the table and moved forward to make contact with the upper jaw.

A toolmaker's clamp is now applied to retain the lower jaw in this position for fitting the two 6-B.A. fixing screws.

This completes the more important part of the work on the jig, and it remains to form the drill slide to its finished shape and where necessary to chamfer the edges; in addition, the edges of the table are also chamfered and the forward end is cut away on the left side to allow the shanks of drills to pass through the caliper jaws. The next step is to mount the jig opposite to the grinding wheel so that the necessary clearances can be filed to enable the jig to be rotated through an angle of 45 deg. for drill grinding. The forward faces of both the table and the drill slide have already been filed to an angle of 59 deg. to clear the grinding wheel, but the upper right-hand corner of these two parts must also be cut away

*Continued from page 796, "M.E.," December 13, 1951.

to clear the wheel as the jig is rotated. The angle of this cut-away is compound and is best determined by trials; moreover, the contour is in part dependent on the height at which the jig is mounted in relation to the wheel. When filing the table, care should be taken not to remove too much metal where the main pivot

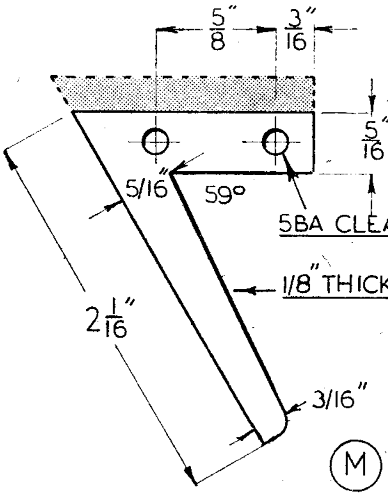


Fig. 38. Details of the stop-arm

screws into the under side of the table; also, the seating of the lip gauge should not be encroached on. After the jig has been finally assembled, the two clamping-screws fitted to the pivot bracket should be adjusted to remove any shake in the pivot bearing and to give some measure of frictional control.

Testing and Using the Jig

The method adopted for testing the jig before actually grinding a drill was to clamp a photographic negative, glass side outwards, to the face of the grinding wheel; the reflection then showed very clearly whether the point of a standard drill kept at an exactly constant distance from the wheel as the jig was slowly operated. In addition, the effect of setting the caliper jaws at a greater or less distance apart than the diameter of the drill shank could be readily demonstrated.

If the caliper jaws are purposely set too far apart for the size of drill, the effect is to widen the base of the cone angle represented by twice the angle formed between the axis of the main

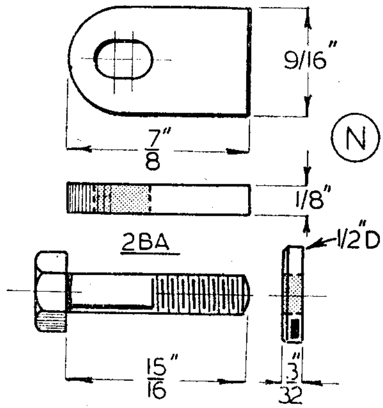


Fig. 39. Details of the stop-plate

pivot and the face of the wheel; this lessens the curvature of the cone and so gives a reduced angle of back-off to the drill point. Conversely, if the caliper jaws are set closer than the diameter of the drill shank, the cone ground will have a shorter base radius and, as a result, a greater degree of curvature and back-off will be formed. In this way, the back-off can if required be increased or reduced at will, but with the finished jig the arris angle remained constant at approximately 125 deg. throughout the range of drills measured with a protractor after grinding.

When setting up the jig for grinding, it may be found an advantage to arrange that the point of the largest drill lies a little below the centre-line of the wheel, for the grinding marks will then cross the drill's cutting edge at an angle.

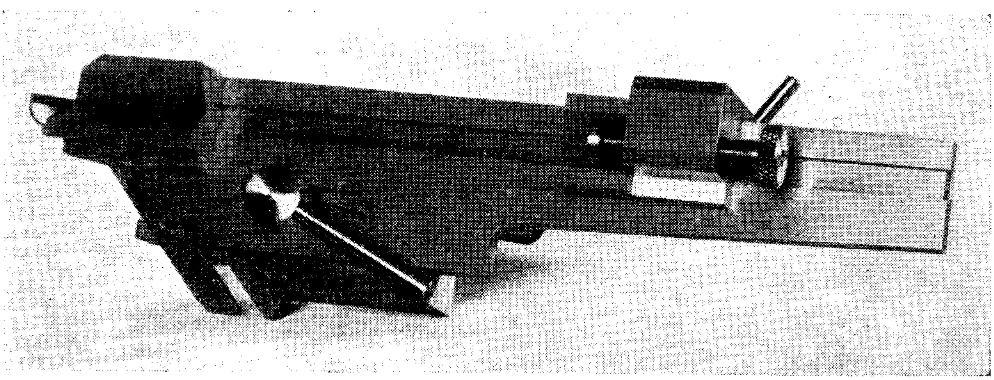


Fig. 40. The finished caliper jaws in place

If the drill point is placed on the wheel centre-line, the grinding marks will be formed parallel with the cutting edge and, in consequence, the extreme edge will be more liable to break off or crumble when drilling. Where the drill point is above the wheel centre, the direction of grinding is away from the cutting edge and a burr may be set up, but with the drill below the centre-line the grinding is, as it should be, towards the cutting edge and no appreciable burr should then result.

To operate the jig, the base bracket clamp-screw

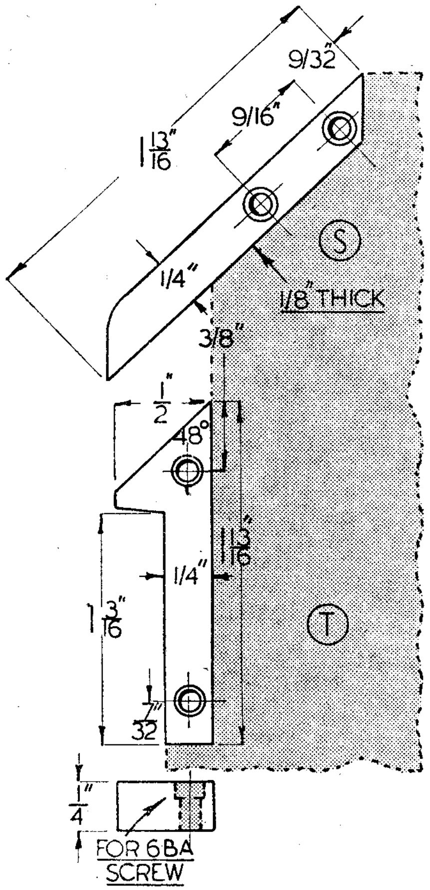


Fig. 41. *Showing the dimensions of the caliper jaws*

is first slackened and the jig moved away from the wheel. After the drill slide clamp-screw has been freed, the caliper jaws are set to grip the drill shank and the screw is again tightened. Next, the jig is rotated to the left until checked by the stop mechanism at the base of the main pivot; while held in this position at an angle of 90 deg. to the wheel face, the jig is moved forwards until a piece of shim material, some 10 thousandths of an inch in thickness, is gripped between the lip guide and the face of the wheel; the base bracket clamp-screw is now tightened. The stop-plate (*N*) is then set to make contact with the foot of the stop-arm (*M*) and the holding screw is well tightened. This setting has to be made once only—at the time of assembly, and lasts until the face of the wheel becomes worn down, or the gap is widened as a result of dressing the wheel face. Before going further, it is advisable to check this setting to make sure that the lip gauge swings free of the wheel face. The drill is next placed in the two V-blocks and the tailstock is adjusted to bring the lower cutting lip against the lip guide when the drill is rotated as far as it will go in a clockwise direction. The wheel can now be started, and the drill is fed forward by means of the tailstock feed screw until the wheel just begins to cut; the jig is then swung to the right with a steady controlled motion until checked by the pivot stop. On again swinging the jig to the left, it should be found possible to remove the drill without the point coming into contact with the revolving wheel, for if the long axis of the drill slide is set at right-angles to the wheel face, by adjusting the setting of the lower collar on the main pivot, the drill point will be just clear, as contact with the wheel is not again made until the jig has moved a short distance to the right. The drill is now turned over and the other lip is ground in the same way and with the same setting of the feed screw.

When sharpening a drill, it is advisable to take a series of light cuts alternately on the two lips, for a heavy cut may draw the temper of the drill. The bearings of the grinding head should be correctly adjusted, as any end-float of the spindle may cause irregular grinding.

A Try Out

The jig was tried out by grinding a series of six drills, ranging in diameter from No. 50 up to ½ in., and, as previously mentioned, the arris angle formed was found to be constant and correct for ordinary drilling. These drills were then tested on mild-steel without using a lubricant, and the chips formed were quite regular and symmetrical. Free cutting was obtained with moderate drilling pressure, and there was no apparent tendency to chatter even when enlarging a pilot hole with the ½ in. dia. drill. All the drills were also put through a piece of mild-steel without preliminary piloting, and the drills themselves were found to be a good fit in the holes so formed. The satisfactory results obtained when grinding the smallest drills with the aid of the special holder have already been referred to.

In the next instalment the making of the ball-bearing grinding head will be described, and a description will also follow of a self-contained portable unit comprising the jig, the grinding head, and an electric motor mounted on a common base.

Readers' Experiences

In response to the request for readers' experiences in making drill jigs to the Van Royen design, two correspondents have very kindly given their views in great detail.

Both writers are agreed that the side-shift of the drill slide to the right, given by a keyway

machined at an angle of 3 deg. 10 min., is insufficient to give uniform backing-off for all sizes of drills. There is also agreement that the ordinary form of fixed lip gauge will not position the smallest drills correctly.

Mr. G. E. Marshall refers to a letter by his late father, published in THE MODEL ENGINEER of September 10th, 1936, in which is told how the side-shift was made adjustable and controlled by a micrometer screw. The lip gauge was also done away with and the drill was held in a chuck resting in the Vs of the drill slide. Two grooves, at 180 deg., were machined on the chuck and its shank for the purpose of setting the drill and also to allow a spring attachment to hold the chuck in alignment. Dr. W. Duncan has got over the difficulty due to the insufficient side-shift by fitting a key that can be swung to an angle of 10 deg. with the drill axis ; this key is adjusted by means of pressure screws and is then locked in position. Again, a lip gauge is not used for controlling the drill point and, instead, the drill is gripped in paired jaws mounted in a holder of square section. The holder itself rests in the drill slide Vs and, to accommodate drills of $\frac{3}{16}$ in. dia. downwards, five sets of jaws and two holders are required.

However, these helpful correspondents will not, perhaps, mind if a few well-intentioned comments are made on their ingenious designs.

For Immediate Use

Most workers will welcome the kind of appliance that is always ready for immediate use with a minimum of adjustment. This being so, a drill jig will usually be preferred that will give the correct back-off for all sizes of drills with but a single setting, and this is possible where the drill slide is permanently set to move forward at the appropriate angle. As previously mentioned, this angle can be determined experimentally by working from the zero position of the drill slide, and adjusting the angle of travel until the reflection of the points of a series of standard drills on a glass surface shows that the correct setting has been obtained. As to the lip gauge, it is satisfactory to learn that others have found this device unsatisfactory for small drills, and that they, too, have been obliged to seek a better way of setting the drill lips. The datum surfaces used for aligning the drill relative to the main pivot axis are the sides of the V-rests, and if the drill is mounted in a holder and the holder rests in the Vs, it is possible that errors may be introduced that will result in irregular grinding. In the first place, if the long axis of the drill rises or falls when the holder is turned over through an angle of 180 deg. for grinding the second lip, the two lips will not be formed at the same height, nor will they be equal in length, as the drill point will be off-centre.

Again, if the amount of side-shift alters as the holder is turned over, the back-off will be unequal. It follows, therefore, that any form of holder to be effective must hold drills exactly central, for even the smallest error in this respect will have a marked, adverse effect when grinding fine drills. This difficulty can, of course, be overcome by precise workmanship, but it may be found necessary to make a number of holders to serve the whole series of small drills. It must, too, be borne in mind that a very small drill has but little rigidity and it must, therefore, be supported almost up to its point ; for if the pressure of the grinding wheel is able to bend the overhanging part of the drill, the point will be irregularly formed.

The small holder described in the previous article would seem to satisfy most of these conditions, for the drill itself is at all times supported directly in the V-rests, and the actual point projects for only 10 thousandths of an inch or less beyond the drill rest. When turned over, the holder is automatically reset at 180 deg. One holder only is required for the whole range of small drills from, say, No. 50 downwards ;

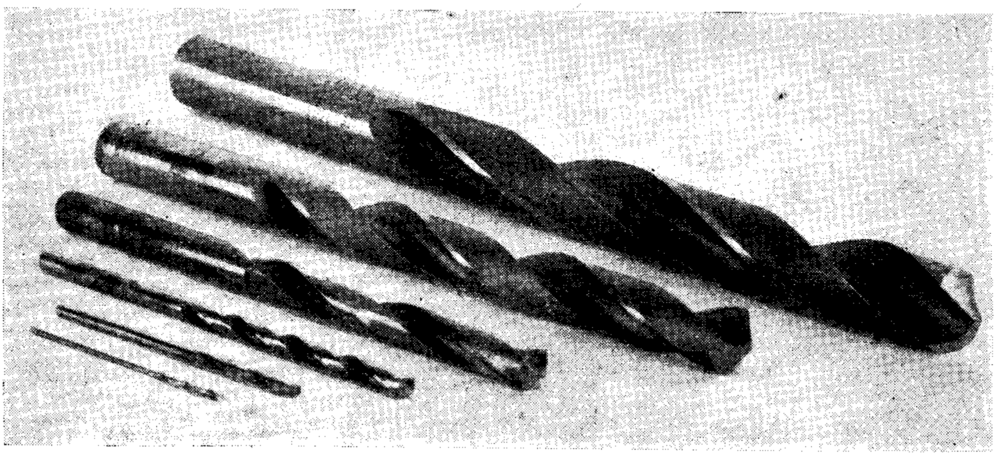


Fig. 42. Drills ranging from No. 60 to ½ in, diameter ground in the jig

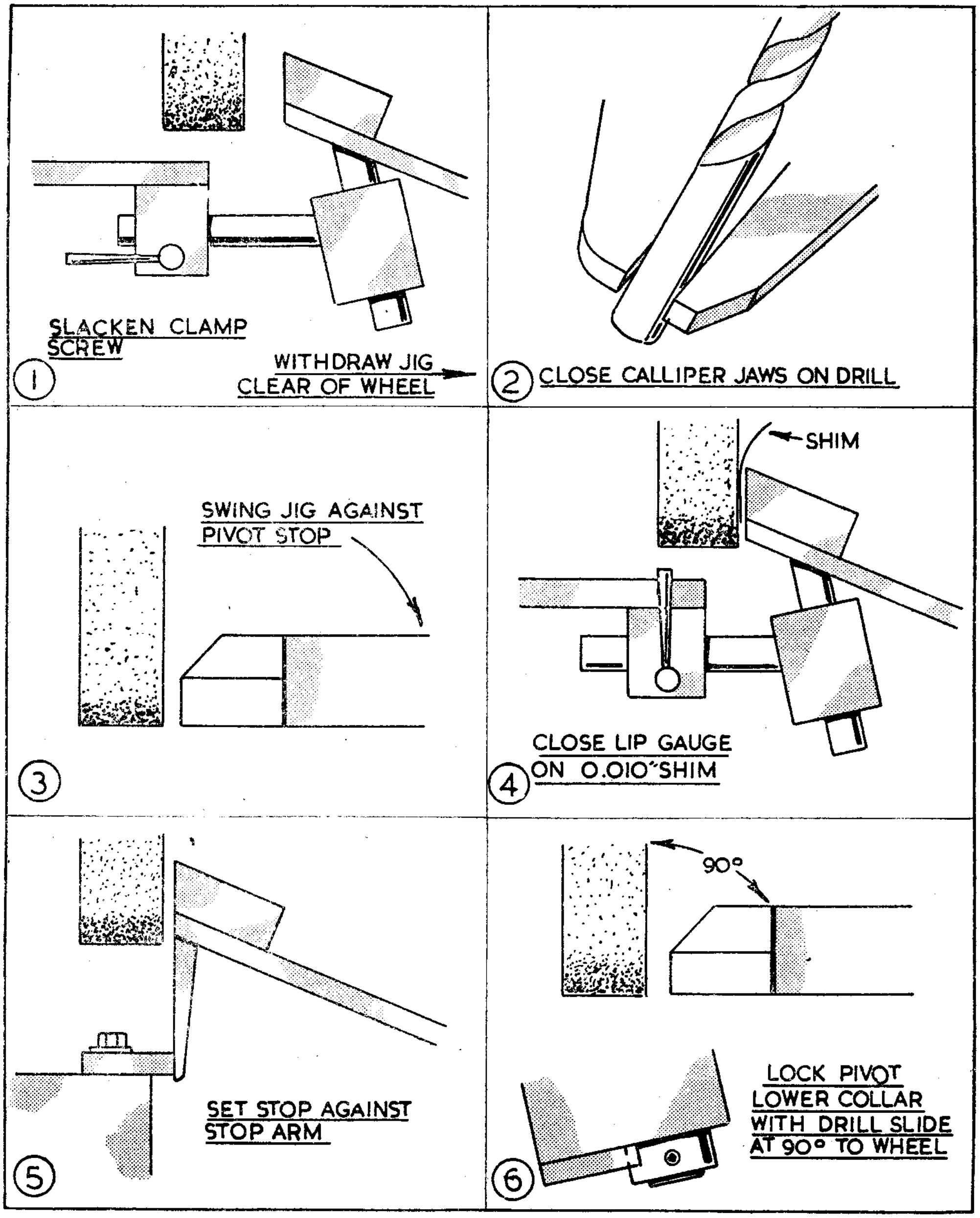


Fig. 43. *Setting up the jig for drill grinding*

moreover, this holder can be quickly and easily made, as it is only necessary to drill a single, accurately placed hole. After merely setting the caliper jaws and attaching the holder to the drill shank, a No. 60 drill can be accurately ground and will then cut freely, forming a hole of nearly the same diameter as the drill itself. It is possible that the cutting pressure may tend to twist the drill on its long axis, but this torsional effect can be largely overcome by setting the jig so that the drill point lies near the centre-line of the wheel face, and the drill is then pressed directly downwards against the floor of the drill rest; moreover, if a fine-grit wheel is employed, the cutting pressure will be reduced and there will then be but little danger of the drill being twisted or displaced.

(*To be continued*)

PRACTICAL LETTERS

Old Whitworth Lathes

DEAR SIR,—In one large machine tool-shop, where I worked, we had two 9 in. × 20 ft. Whitworth lathes. These were exactly the same in casting design as the $3\frac{1}{2}$-in. lathe pictured in the October 18th, 1951, issue of THE MODEL ENGINEER but were much heavier, with central leadscrew, which was also used as a rack for moving the carriage. There was no apron on the front of the carriage, the casting itself being thick over the bed top and bored for shafts, all gearing mechanism being underneath this in the bed-centre. Automatic traverse was engaged by pulling a handle at front of slide, this worked a scissor action and closed a two-part nut on the leadscrew. Cross-traverse was engaged by tightening a nut at front of cross-slide screw, this closed a friction-clutch, driven by bevel and gears on a sliding keyway in the leadscrew. The lathes were driven by four-speed cone, flat belt and backgear; overhead drive by open, and cross-belts for reversing lathe. The gear for belt shifting being a shaft full length of bed front, this being either pushed or pulled to get correct rotation. Fast and loose heads were bored No. 4 Morse, sufficient room being left on the fast head between front bearing and first gear for a slot through spindle for driving out tangs. The headstock bearings were conical. To the rear of each machine was a long wooden box containing a special leadscrew with no keyway in, which could be put in the machines for special jobs. I never saw these used. The castings were beautifully finished and were painted a dark green. Both these machines were sold in 1942, to be used in another workshop, so they are probably still in use as they were in very good condition.

Yours faithfully,
Luddenfoot, Yorks. G. W. WHITWORTH.

Re. Fixing Barrel Pins in Musical Boxes

DEAR SIR,—I have had numerous musical boxes in the past, and as far as I am aware all the pins are secured in the barrel, which is a thin piece of tube, by shellac or similar cement. Provided that they have not been unduly knocked about, most pins can be eased up straight. The major cause of bent pins is through taking the governor out whilst there is still tension in the driving mechanism and the barrel racing round.

An old model engineer, Mr. Bygrave, now deceased, told me that years ago there was an Italian firm in London who would put you on a barrel for two or three shillings.

The method adopted was to lay the tune out on a piece of paper equivalent to the circumference of the barrel. The paper was then glued around it and the holes picked up and drilled through, a layer of shellac was then spread over the inside of the pins inserted, the pins being picked up with a small disc punch with a hole in the end, the depth of the hole determining how far the pins are left proud of the barrel.

The old type of barrel musical box is now getting rare, as apart from usual wastage, the American soldiers over here during the war years were great collectors. The newer or modern version is, of course, about again now, and the effects are as sweet as ever.

My most interesting repair was one fitted into a clock. I believe it was of Italian origin.

Musical boxes and the old fair ground steam organ represent very intriguing subjects, too, and I should be more than pleased to hear more of them.

Yours faithfully,
Whitburn. FRANK H. PRICE.

Musical Boxes

DEAR SIR,—Perhaps my experience in the repair of musical boxes may be of use or interest. Many years ago, as a boy I got friendly with a good practical watch and clockmaker, and finding me interested he soon began to let me help him. One of the first things he showed me was how to file taper pins and the correct method of twiddling a pin-vice to get the pins truly round. Then he began to let me re-peg damaged musical-box barrels—we got all sorts. Some tiny ones about 4 in. diameter in plated metal cases with a handle on top, on turning which, a tinkling sound was heard. Others were concealed in beer mugs, soup plates, etc. Then we also got the old-fashioned ones in plain polished boxes, the comb having a large number of notes and playing a good selection of music. Later sorts seemed got up more to please the eye than the ear. The cabinets were inlaid, the fittings gilded, the combs shorter and less notes. To make up for the loss, they had a tiny drum which sounded like tapping the parchment top of a jam jar with a lead pencil, and two or three bells struck with ornate hammers in the form of gaily painted butterflies. Most we got were choked with dirt and thick oil. First we took the comb out in case of accidents. Then the train was run down, a little mineral oil or benzine on the pivots helping. When it had done its last kick, the gears were locked with a bit of peg wood and the fly removed. Remove the peg wood and you will most likely get a few more kicks out of it. But never trust a spring, give the barrel a turn by hand till it is absolutely dead. Then you can dismantle the whole thing. Cleaning the train, etc. is ordinary clockmaker's work and is best done with a four-row bristle brush, rotten stone and oil followed by a soft brush and chalk. The barrels we treated much as advised by Mr. H. A. J. Lawrence in your issue of November 15th last. We melted the cement out over a flat flame bunsen, keeping the barrel well above the flame so as not to soften the pins. New pins we filed from piano wire, remembering not to file them down to finished length till the new cement has been run in. In re-pinning I used to lay the barrel in a rough wooden vee-block lined with thick carpet felt. If we wanted

cement we used the old-fashioned turners' cement which I think was made of pitch resin and a bit of beeswax. For the tiny ones we often used that cement beloved of watchmakers, shellac. A broken comb tooth is a nasty job. I have seen them repaired, but never did one, so I will sing small about it.

Yours faithfully,
Luton. ERNEST W. FRASER.

Rust Prevention

DEAR SIR,—Mr. Scott in his letter in October 11th issue is mistaken in holding that a prerequisite for the condensation of water vapour from air is a rapid rise in the air temperature, and for the very reason that he adduces: that warm air will hold more water in solution than cold, from which it follows that a rise in air temperature, whether rapid or not, will make it less capable of precipitating liquid water. There is only one cause of condensation; the chilling of air below its dew point. Our aim should therefore be to ensure that when a change of wind brings into our workshops a quantity of warm air that has passed over a large expanse of damp while still warm, we are not taken by surprise. This incoming air may have absorbed, by virtue of its warmth, a greater amount of water than it is capable of holding at the lower temperature of the workshop. It will then part very readily with some of its heat to whatever takes up heat quickly, such as a metal, and particularly one with a high specific heat; such a metal will take up a relatively large quantity of heat without a proportionate rise in temperature.

Mr. Scott's method of avoiding rust is effective but far from efficient; it is expensive, on his reckoning, costing nearly 4 per cent. per annum of the capital value, which is twenty times as much as insurance against fire and theft, and for most of the time it is unnecessary.

A film of oil protects steel in three ways; as a thermal insulator it reduces the rate of heat exchange between the cold steel and the warm moist air, thus allowing supersaturated air to be moved away, by the same currents as brought it there, before it has time to precipitate; because of the high interfacial tension, it makes any precipitated droplets retain a spheroidal shape and so allows them to fall away wherever they can; because oxygen is virtually insoluble in oil, a film of oil excludes from the steel that it covers the only substance essential for rusting.

Ventilation should be avoided; large steel masses should be kept shut up so that the ambient air is at their temperature, and if the atmospheric temperature rises, that of both steel and ambient air will rise together. Large masses of steel that cannot be shut away should be covered with almost any kind of material, to keep moist dust from settling on them; for the same reason the workshop floor may be treated with spindle oil if of wood, and with silicate of soda (water glass) if of concrete.

These two measures are of themselves enough for all but extreme weather, but may be supplemented with oiling, and with artificially warming relatively large masses of steel when, after a cold spell, a warm moist wind arrives, whose dew point is higher than the temperature of the steel. It is the steel itself that causes the condensation that makes it rust; being a good conductor of heat, when it is surrounded by air warmer than itself it quickly abstracts heat from that air, and so warms itself and chills the air. If it chills the air below its dew point, condensation will follow.

Yours faithfully,
Edinburgh. G. STRUAN MARSHALL.
(Group Captain)

Model Steam Turbines

DEAR SIR,—It was with the greatest possible interest and pleasure that I read Mr. J. A. Bamford's account of his experiments with a flash steam turbine in your issues for October, 11th and 18th 1951. Although his work must have been going on at much the same time as my own, we were quite unknown to each other, and have not had until now, an opportunity to compare results. If I were doing my work over again, there is much that I should be glad to copy from Mr. Bamford's design; the general robustness of the construction, for example, where mine is too delicate, although I should not, I think, choose a wheel as large as $3\frac{1}{4}$ in. diameter for a single steam nozzle only 0.037 in. diameter at the throat.

The "treacle tin" brake is an absolute stroke of genius and I do congratulate Mr. Bamford most cordially on it. It is simple, cheap and reliable and gives accurate horse-power readings. There is endless scope for this brilliant sort of improvisation in experimental model work, and it is a pity it is displayed so seldom.

Although Mr. Bamford's wheel runs more slowly than my own, it is the blade speed that counts and it is interesting to compare the two plants on a basis of blade speed, in feet per second and steam consumption in lb. per horse-power per hour. In this I quote figures recorded at an S.M.E.E. Stationary Engine Committee Test on March 10th, 1951 when my plant gave a net output of 0.248 h.p. running at 118.000 r.p.m. with a steam consumption of 3.53 oz. per min.

	Blade Speed ft./sec.	*Specific Consumption lb./H.P./hr.*
Bamford ..	777	112.5
Chaddock ..	644	53.5

My own conclusion from these figures, with which Mr. Bamford may not agree, is that although the blade speed is high in both examples, the large wheel in his model is causing excessive windage loss and pulling down the power, and hence raising the specific steam consumption. In my new turbine, now under construction, the wheel is somewhat smaller than the last one and designed to pass about the same amount of steam as Mr. Bamfords model uses. The object of this, of course, is to have as many blades as possible completely filled with live steam and doing useful work, and as few as possible fanning round and absorbing good horse-power.

I do most sincerely hope that, after such a promising start, Mr. Bamford does not allow his project to die, because I feel we are only at the beginning of some really remarkable developments in model turbines.

Yours faithfully,
Sevenoaks. D. H. CHADDOCK.